

# Cultivating local champions for mentoring colleagues through integrated e-learning within District Health Information System

*A quasi field experiment in Malawi*

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Master thesis, Department of Informatics

UNIVERSITY OF OSLO

May 4<sup>th</sup> 2015

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Cultivating local champions for mentoring colleagues through integrated e-learning within  
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# Abstract

Learning how to use distributed business systems requires expensive and sustained training efforts, and this study addresses the need for sustainable and effective training solutions, and an approach to nurture local users to become mentor for colleagues has been developed as an alternative to training courses. The objective of the study was to find the sufficient training and support to cultivate mentors, how e-learning courses should be designed considering areas with poor Internet connectivity and how contents of such an e-learning course should be structured.

Our empirical fieldwork was conducted in two cycles, exploration and evaluation cycle, and the study used a combination of quantitative and qualitative research methods. Through an in-app solution in District Health Information System 2 (DHIS 2), e-learning courses can train users. Since the system can go offline without losing data, and training is set in a country with poor Internet connectivity, an e-learning app within the system is a good solution so there is no loss of data or disruptions during training.

A basic user level plus a mentor level distance e-learning course were evaluated amongst users of DHIS 2 in Malawi. The user level course was adequate for users with some computer fluency, while IT novices required a mentor present. The mentor level course required the mentors to have higher system competence than most of the relevant users had. An advanced level course between the user and the mentor level is suggested, in addition to including more practical and cooperative, reflective components in the mentor course. With such amendments, distance e-learning courses can replace most face-to-face training courses and training of trainers approaches for implementation of information systems.

**Keywords:** User training, user learning, Health Information Systems, e-learning, mentors, champions.





# Acknowledgement

Finally we are completing this complex and very interesting thesis, it has been a journey. We would therefore take this opportunity to thank all of those who have contributed to our work in one way or another.

We want to express our gratitude to our main supervisor, Jens Kaasbøll, for your patience, support and your good advices throughout this process. Our trips to Malawi have been a pleasure with your guidance and knowledge. We also extend our gratitude to Matthieu Pinard who has dedicated his time and provided valuable guidance and contribution to this thesis. Our gratitude goes to HISP Norway for making this thesis possible, and to all the persons that has contributed in Malawi.

Ellen: I would like to give my special thanks to my sister Kristine, mother Alvhild and father John, to my boyfriend Magnus, and to colleagues and friends at Amnesty International. Thank you for all support, guidance and patience during this work. It has been priceless.

Anniken: I would like to give my special thanks to Mika for your love and support, for always being there for me, and your endless patience through this process. This could not have been done without you. To my sisters Christina and Helene for cheering me on, and making me laugh. At last, in loving memory of my mother, this is done for you.

***Ellen Marie Bjørge and Anniken Jønsson***

University of Oslo

May 2015



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# Abbreviations

AR	Action Research
BL	Blended learning
CHAM	Christian Health Association of Malawi
CoP	Communities of practice
DHIS	District Health Information System
DHO	District Health Office
HDI	Human Development Index
HIS	Health Information System
HISP	Health Information System Programme
LMIC	Low and/or middle-income countries
MPS	Motivational Potential Score
MoH	Ministry of Health
XPD	Zone of Proximal Development



# **1 Introduction**

## **1.1 Study background**

Outbreaks of disease and catastrophes can happen to countries at any time, and an example of this is the current Ebola virus disease outbreak in Western Africa. If health systems in these countries are weak, it cannot be resilient (Kieny et al., 2014). If the country has a strong health system it can provide a high level of preparedness of crisis because of the infrastructure health systems give. The introduction of ICT in developing countries has been marred by “pilotitis.” A seemingly endless stream of ICT interventions die out after the donor has left due to poor institutionalization. There are several reasons why ICT systems are unsustainable, and this research addresses low user competence, which is, particularly in rural areas, one system killer (Kimaro and Titlestad, 2008).

## **1.2 Setting**

This thesis is a part of the Health Information System Programme (HISP) in Norway, which is a global network established, managed and coordinated by the Department of Informatics at the University in Oslo (Health Information System Programme, 2015). The overall goal is to enable and support countries to strengthen their health systems. The core project is the development of the free and open software DHIS 2 (District Health Information System 2). This is a tool for collecting health data, ensuring quality data, analysis and presentation of data (Health Information System Programme, 2015). This creates a better management for decisions and coverage and the system is implemented in more than 40 countries.

The setting for our research will be the Health Management Information System (HMIS) of Malawi, where the integrated DHIS has been implemented. Malawi has 29 district offices where data is entered from paper forms into the system. In each office there are twenty or more health programme coordinators, one HMIS officer who has HMIS with the DHIS as their prime task and a few clerks that helps out on data entry and other related tasks. DHIS 2 in Malawi runs through a web browser and stores data in a national server. Due to the number of data concepts (organisation unit, data element, period, data set...) there is no easy fix to make it simple at the user interface.

## **1.3 Personal motivation**

Starting our master in informatics, the choices were many due to all the areas that informatics encompasses. Having the possibility to use our interdisciplinary background from pedagogics and informatics to contribute in developing a more sustainable and cost-effective training program has been a personal motivation for us during this thesis. We would like to contribute that health workers, HMIS officers, clerks and others get the training they need to be confident in their work and that they can do their jobs well, even though the resources are low and the challenges are many.

## **1.4 Training**

Today training in the system happens locally in district health offices, resources in the system such as manuals and training through academies organized by HISP Norway. The academies aims to strengthen the national and regional capacity to successfully set-up design and maintain DHIS 2 (DHIS2, 2015). This is an intensive training program lasting for a week and is run as annual regional training workshops in Eastern, Southern, Western and Central Africa, Asia and Latin America. The academies are for Program managers, statisticians, programmers, developers, national teams and so on, and there are approximately 50 attendants to each gathering. These training sessions go through the cycle of information, regarding topics as strategy and decisions, data collection, data analysis, data dissemination. They also contain details of database management and server maintenance. Training for end-users of the system are on the other hand often done locally in the District Health Offices, with trainers from the national team. This training is not standardized and varies from district to district. Since DHIS 2 is implemented in more than 40 countries, it means that there is approximately 50 000 end-users.

In general, training in basic ICT plus system specific skills followed up by regular support visits were found necessary for a health information system innovation to succeed (Ngoma, Kaasbøll & Aanestad, 2008). In other settings, the need for local support has been addressed through training some users more than others, such that they become mentors who are able to support, guide and encourage other staff on using an ICT system (Coulson et al., 2003; McNeive, 2009). While acknowledged as a viable strategy towards sustainability of the systems, the approach so far has been to just provide more training for those selected to

become mentors. This is an expensive method when scattered trainees need to join up for several days in a central city

Also, efficient methods to train up to the mentor level have not been scientifically tested; implying that high cost training may yield limited results. Previous research points to that training which aims at understanding underlying structures in the system combined with explicit teaching of problem solving techniques and principles for how to guide others may bring learners up to mentor level (Kaasbøll, 2013)

## **1.5 Research objective**

Training should reach out to potential mentors in rural districts and an approach to achieve this is to use distance training through e-learning courses. Local users could be nurtured to become mentors for colleagues and this would be a more sustainable approach than today's methods as explained in the previous section. Our research questions are as follows:

1. What is sufficient training and support to make people who are neither managers nor computer scientists able to champion and support a health management information system at their workplace?
2. How can e-learning courses be designed to improve user competence in areas with poor connectivity?
3. How should the contents of training courses be structured in order to cultivate champions of DHIS 2?

## **1.6 Structure of thesis**

In this section we will give a brief overview of the different chapters in this thesis, which has seven chapters in total.

### **Chapter 2 – Literature review:**

In this chapter we will present relevant literature and research that is relevant to our thesis. The areas we have chosen to focus on are scaffolding, e-learning, mentors, cultivating champions and how training can be transferred.

### **Chapter 3 – Study context:**

In this chapter we give a short introduction to Malawi and Health Management Information Systems. We also provide an overview over DHIS 2 in general and in Malawi.

### **Chapter 4 – Methodology:**

Here we present the research approach and the different methods used in the thesis to answer the research questions. Collection of data has been carried out in two cycles and these are the exploration cycle and evaluation cycle. Ethical considerations and the constraints in this thesis are also described.

### **Chapter 5 – Exploration cycle:**

In this cycle we investigate our research question number two, on how e-learning courses can be designed to improve user competence. We did get some ideas on this and based on our findings we have made a design suggestion for the e-learning courses. Due to time constraints, we could not implement the actual e-learning app. Further we present the findings from our first visit to Malawi, and its analysis.

### **Chapter 6 – Evaluation cycle:**

In this cycle we investigated research question number three, on how the contents of training courses should be structured. First we describe the design process of the basic user and mentor course. Then we present our findings from trying these in Malawi and analyses.

### **Chapter 7 – Conclusion:**

A summary of the findings and our conclusion are presented in this chapter, as well as our recommendations, limitations to the research and our suggestions to further research.

### **Appendices:**

Appendix A consists of the approval from Norwegian Social Science Data Services for processing personal data.

Appendix B displays the questions in the questionnaire.

Appendix C contains the interview guide used in the exploration cycle.

Appendix D is the first design of the Visualizer and Dashboard module used in the exploration cycle.

Appendix E is the third design of the e-learning courses used in the evaluation cycle.

Appendix F contains two articles we have contributed in writing, and parts of that material is used throughout this thesis.





## 2 Literature review

In this chapter we will present literature and theory that is relevant for our research. We will review literature regarding learning and learning strategies with the aim to understand how one can learn with the help from computer tools. Further we will look into how mentors can be cultivated and how transfer of training can occur.

### 2.1 Traditional learning theories

Learning can be defined as a long-term change in mental representations or associations as a result of experience (Ormrod, 2008, p. 4). Through the years two traditional areas have dominated learning theories, and these are behaviourism and cognitivism (Woolfolk, 2004). In behaviourism, learning is defined as change of the external and observed behaviour where learning builds on the physical experiences of an individual. After the period of behaviourism in the early 1900, the cognitivist revolution came in the beginning of the 1960's. Within this perspective, the focus is on internal mental processes where one divides between the body and the intellect. The element of cognitivism that has had the most influence within pedagogics is constructivism that emphasizes that an individual constructs understanding of the surrounding world through activities. Learning in this theory will according to the Swiss psychologist Jean Piaget, be constructed through schemas that contains a person's thought system that categorizes perceptions and experiences. For processing information into these schemas there are according to Piaget two internal processes that occur for adapting to the surrounding and these are assimilation and accommodation. Assimilation occurs when a person uses his/her existing mental schemas to understand the world phenomena's. That is one understands new knowledge by using already existing knowledge. Accommodation on the other hand happens when a person creates new knowledge in new schemas. A person often experiences an aha-feeling when this happens (Woolfolk, 2004, p. 55).

An alternative to the cognitivism is the sociocultural perspective that assumes that learning occurs through language and social participation, and that knowledge is created jointly with others. This perspective is based on the Russian psychologist Lev Vygotsky's (1896 – 1934) work. He believed that learning is something that happens in a social context and in interplay with others. One of the theories that he is known for is the zone of proximal development

(ZPD). This theory says that learning should be adjusted to the learner's level of development and it is defined by Vygotsky (1978, referenced in Wertsch, 1991) as "the distance between a child's actual development level as determined by independent problem solving and the higher level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 28). This means that the skills and knowledge contained within the ZPD are the ones that have not emerged yet, but can emerge if they get the right assistance and help. In relation to zone of proximal development scaffolding is a support structure.

## 2.2 Scaffolding

Scaffolding can be described as helping learners to succeed in solving problems that would be too difficult for them otherwise (Quintana et al., 2004, p. 337). This means that scaffolding happens when a teacher or more knowledgeable peer helps solving a problem that would be too difficult to solve alone. This also helps learners to accomplish tasks within their zone of proximal development (Quintana et al., 2004, p. 340). By using hints, prompts and questions the learner will have to figure out a problem by themselves, and in that way actively construct knowledge. The term scaffolding is wide and used in different settings. Quintana et al., (2004, p. 345) has therefore created a scaffolding design framework to create digital learning tools. The design framework has three processes, which are sense making, process management and articulation and reflection. These three processes are divided into seven scaffolding guidelines. Sense making is the basic operations for hypothesis testing and interpretation of data. Process management are the strategic provisions that control the inquiry process and articulation and reflection is the process to construct knowledge and to evaluate. The framework is illustrated in Table 1.

Scaffolding guideline	Processes
<ol style="list-style-type: none"> <li>1. Use representations and language that bridge learner's understanding</li> <li>2. Organize tools and artefacts around the semantics of the discipline</li> <li>3. Use representations that the learners can inspect in different ways to reveal important properties of underlying data</li> </ol>	<b>Sense making</b>

4. Provide structure for complex tasks and functionality 5. Embed expert guidance about scientific practices 6. Automatically handle non salient routine tasks	<b>Process management</b>
7. Facilitate on-going articulation and reflection during the investigation	<b>Articulation and reflection</b>

**Table 1: Scaffolding design framework**

### **2.2.1 Conceptual models in training modules**

The use of conceptual models can help novices in a learning situation, and been defined by Mayer (1989) as “words and/or diagrams that are intended to help learners build mental models and actions in a system as well as the usual relations among them” (p. 43). Studies have shown that novices benefits from the use of direct instructions on how to construct a conceptual model for the material to be learned (Mayer, 1989). The conceptual models will allow the learner’s to think systematically and to explain the information that is given. But what is a good conceptual model? Mayer (1989, p. 59) has listed several functions that make models good and these are complete, concise, coherent, conceptual, correct and considerate. Complete means that the model, contain all the essential parts or actions of the system as well as the relations between these. In our case this means that the topics the e-learning module is covering, should have all essential information. Further the models should be concise, meaning that all details in the model should be presented at a level that is appropriate for the learners and that they don’t give to much information. Coherent means that the models will make an intuitive sense of how the operation works and conceptual means that the material explains how the system works. The two last functionalities, correct, which means that the material at some level corresponds with the actual event or object they represent and considerate, which means that the material is presented in a manner that is appropriate to the learner.

Further recommendations from Mayer (1989, p. 60) are that conceptual models are effective if they are integrated in the lesson or placed before the lesson.

### **2.2.2 Human scaffolding - Superusers and mentors**

In most organizations the use of superusers are there formally or informally. Superusers can be defined as “workers who have acquired sufficient skills to utilize modern day information systems applications” (Boffa and Pawola, 2006, p. 61). In our thesis we have chosen to use the term mentor instead of superusers, and we will refer to mentors further in this thesis. The reason behind this is that superuser is a multifarious term and can be used in different contexts.

Mentors are users that have developed good skills in using computers and they can offer support to their colleagues. In some organisations mentors have more privileges in the computer system than others (Kaasbøll, 2015). In this thesis we have focused on mentors who have the competencies to help others, and not the administrative rights in the system. Selecting mentors can be difficult and they should have some characteristics (McNeive, 2009). They should be willing to embrace the technology and be patient while teaching others. When new changes are brought to the technology, they should be flexible and willing to embrace and champion the new changes. This is important, since they should be communicators for the system, and teach others. Mentors do not necessarily work in an IT department and they can be HMIS officers, clerks, nurses or teachers.

### **2.2.3 Champions**

In order to succeed with new innovations and new product ideas, literature implies that the use of champions is often the key (Beath, 1991; Howell 2005). Champions can also be used to create sustainability over time and has been defined as “individuals who informally emerge to promote the idea with conviction, persistence and energy, and willingly risk their position and reputation to ensure the innovations success” (Howell, 2005, p. 105). In our research we define champions as mentors and these are not formally appointed as leaders or promoters in the organization, but do this voluntary because they want to. There can be both ineffective and effective champion and they differ in the way they get confidence from managers and key stakeholders. An effective champion will promote the innovation in the organization through several internal channels, while an ineffective champion do not put as much effort into this (Howell, 2005, p. 110). An effective champion will also crave new knowledge, and scout for opportunities in external and internal material. The three characteristics a champion

withholds are contextual knowledge, control orientation and self-monitoring (Howell, 2005, p. 114).

Howell (2005) further describes two strategies on how effective champions can influence their key stakeholders to go for the new initiative. These are framing the innovation as an opportunity and using informal selling channels (Howell, 2005, p. 112). The first strategy is to sell the new innovation as an opportunity and not as a threat. To engage others, they must see a vision of positive organizational benefit. The second strategy is to sell the new innovations through informal channels. These informal channels can be private meetings with relevant persons, hallway conversations, one-to-one appeals and so on (Howell, 2005, p. 113).

In order to cultivate users into becoming mentors, it is crucial that the mentor develop knowledge as well as the mentee. Research has argued that reflective knowledge building results in better understanding, while knowledge telling will not advance the mentors knowledge (Roscoe and Chi, 2007, p. 541). Knowledge building means that the mentors need to reflect upon their own expertise and build upon their prior knowledge. During training sessions, mentors should explain and question their mentees, instead of just telling the mentees what to do. By doing so it can lead to scaffolding interactions, where the mentors and mentees interact and gradually develops both their knowledge. Although the mentors' knowledge is likely to be more advanced than their mentees, it takes time to develop expert domain knowledge (Roscoe and Chi, 2007, p. 545). This can make it difficult for mentors to explain the problem, instead of just telling what the problem is, and it can be difficult to ask the right questions.

#### **2.2.4 Learning IT use for mentors**

Learning IT skills is a fundamental part for IT users, without they would not be users. Therefore a focus on skills should be the main aim for IT training and when making training material. However, when it comes for the more advanced users, such as mentors, there is also a need for expressing why the relevant IT mechanisms works as it does to be able to help others and solve problems. That is, they need understanding and problem solving competence. Kaasbøll (2014) states that there are three steps which is necessary for mentors to go through when learning IT use and these are:

1. Skills: Learning IT skills can be done in two different ways, repetition and imitation. With repetition one does the same behaviour several times to strengthen already known skills. A way for learning new skills is imitating others behaviour, or by following instruction from a teacher or instruction sheet.

2. Understanding: When one learns IT skills, the ability to express why for instance an IT function in a system works a specific way does not come automatically. For this one needs understanding. Like Kaasbøll (2014) says

Understanding is complementary to skills, and it includes why mechanisms work like they do or knowing whom to deal with. Understanding is also called theoretical competence, know-why or textbook knowledge, since it can be learnt from reading books (p. 12).

Kaasbøll (2014) explains the reason for needing IT competence by saying that “understanding will in general ease transfer of skills to new situations, like the introduction of new software versions, systems, gadgets and IT services” (p. 12). This understanding is also shown to lead to better abilities for problem solving (Kaasbøll, 2014).

3. Problem solving competence: For a mentor it is expected that one should be able to help others, to find out things that one do not know, and to solve problems. It is therefore a need for problem solving competence, and by knowing relevant IT skills and having an understanding will lead to better abilities for this (Kaasbøll, 2014).

### **2.2.5 Community of practice**

From Wenger (1998) the theory on community of practice (CoP) has three essential elements and these are domain, communities and practice. So, for a CoP the members share a domain of interest where they collect and share their competence with others. In that way they share competence in handling with the domain. Then they form a community with engagement in joint activities where they help each other and share information. The last element is practice, which is what one does that gives the activity meaning and structure. Meaning that it is a shared repertoire of practice through collected tool experiences, and ways of addressing repeating issues. Example of this can be cleaners in a hospital, bus drivers in a bus company, or in our case mentors within DHIS 2.

A community of mentors practice has a foundation in this theory and emerged from the need that companies have to decrease the distance between IT and the user communities. This group should engage in activities together and meet to exchange experiences specifically on mentor activity or role (Kaasbøll, 2015, p. 164). In our mentor course we will try to create a group like this called mentor group, where we will make the mentors send messages by giving them assignments to do it.

## **2.3 E-learning**

Technology has evolved quickly through the years and our society changes with this development. In the last years, e-learning courses has increased and it is used in schools, business and in organizations. Since technology changes rapidly the history of e-learning are short and it is characterised by this. The term is new and there are different kind of e-learning solutions and definitions. In this research it has been defined as “the use of computer network technology, primarily over or through the Internet, to deliver information and instruction to individual” (Welsh et al., 2003, p. 246). There are two main methods to create the material for e-learning courses. One is that a facilitator creates the learning material; the other is that material is created by a professional group or expert (Engvig, 2010). A third option is a combination of these. Then a professional company creates the core material, and the facilitator can add material to this. E-learning can consist of different types of material, such as presentations with lectures, multimedia presentation, simulations and wikis. In our research we have adopted a version of e-learning consisting of pre-produced course modules that we as researchers have developed.

Research from a synthesis of over 800 meta-analyses, written by Hattie (2009) can give us an indication if the e-learning courses will work. These meta-analyses are conducted in schools, and not in organizations, but we have chosen to use this as a foundation regardless. Hattie’s (2009) research is presented by effect size ( $d$ ) on a rank between -0.2 and 1.2 where  $d = 0.4$  is the average. Web-based learning has a score on  $d = 0.18$ , and this can indicate that the effect is low (Hattie, 2009, p. 227). The hope is that “the potential of web-based instruction will increase as pedagogical practises improve, advances in standards for structure learning content programs, and improvements with bandwidth are made” (Hattie, 2009, p. 228). This can indicate that it is not the tool (i.e. web-based) in our e-learning courses that will have an effect on learning, but the content of it. Distance learning has a score on  $d = 0.09$

and scores even lower than web-based learning (Hattie, 2009, p. 232). These results are equivalent to no learning at all. Because of the high amount of end-users in DHIS 2 and the practical and economical challenges it is difficult to reach out to all users in a different way. Due to this it is necessary try out a distance learning approach anyway.

Distance and web-based training has in general had modest success, and the intermittent electricity supply and unpaid Internet subscriptions which are often the case in the research setting makes e-learning more challenging. However, studies have suggested that there are some functionality that will enhance learning (Cook et al., 2010) and these are interactivity, practice exercises, repetition and feedback. In addition to these functionalities, one can facilitate interactivity through blended learning (BL) and the main objective of this is to “enhance learning outcome by combining two kinds of learning environments, one associated with online learning and the other conventional teacher-led classroom learning” (Kudrik, Lahn and Mørch, 2009, p. 956).

### **2.3.1 CSCL**

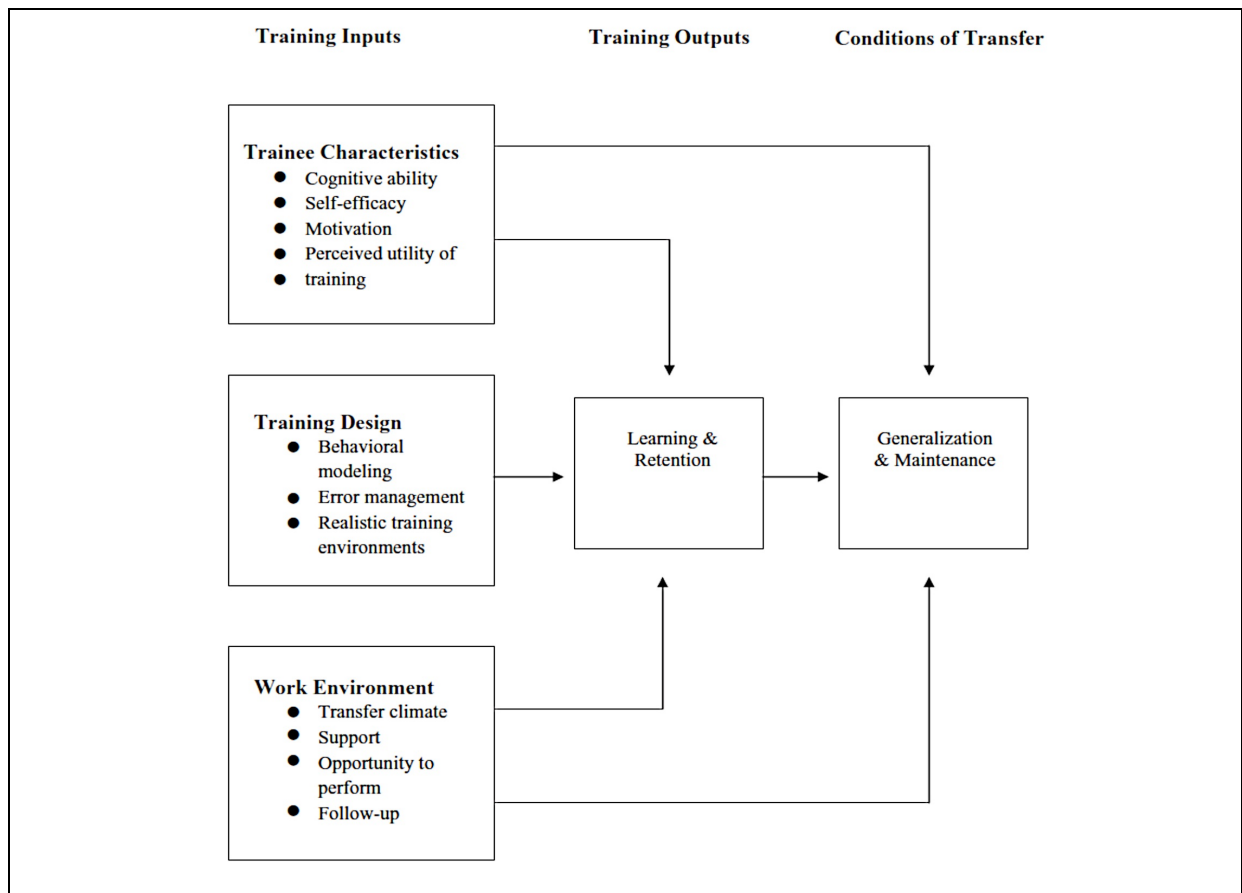
The field of Computer-supported collaborative learning (CSCL) focuses on how learning can take place through collaboration and help from computers. It differs from e-learning in the way that it emphasizes collaboration among the trainees, in contrast to reading material that is posted online in an e-learning course. If the reading material is put into a motivational and interactive context, they can still be effective (Stahl et al., 2006, p. 2). The CSCL field makes a distinction between cooperation and collaboration, and this is useful in order to separate the field from earlier research. Cooperation is often done in the way that trainees split the work amongst themselves, and then done individually. At the end of a cooperation work, they will share their material and learn from this. In collaboration on the other hand, learning occurs through a collaborative construction of knowledge, and it will involve processes of negotiation and sharing of meanings (Stahl et al., 2006, p. 3). Computers can be used as a medium for such collaboration, and the Internet is a good facilitator for this. The computers provide media of communication such as e-mail exchange, discussion forums and instant messaging. This will help support collaboration among the trainees. Collaborative learning will not reduce the learning to be individual, but on the other hand it will also support individual learning (Stahl et al., 2006). The intention behind the e-learning courses is to use collaboration from CSCL, in order to create knowledge.



## **2.4 Transfer of training**

Learning in schools and in organizations is different in the way that traditional school learning has been formal, individual, abstract, long-termed and often decontextualized. In organizations on the other hand, learning have often been informal, done collaboratively, more practical on specific tasks and use more diagrams and models. The knowledge one creates in schools is often explicit, while knowledge gained in organizations remains tacit (Tynjälä and Häkkinen, 2005). In our thesis we want to develop training material that is easy to understand and to do during work hours. So how can training be transferred in a good way to accomplish effects?

Training can be defined as “a systematic acquisition of knowledge, skills and attitudes that together lead to improved performance in specific work environment” (Grossman and Salas, 2011, p. 104). Conducting training can help create motivation, productivity, better quality and fewer errors. To combine what employees need to know with what they already know is desirable through training, and effective training will lead to changes in work performance (Grossman and Salas, 2011). The change of the work performance is essential for it to be successful, and if it does not lead to changes, it can be called a ‘transfer problem’ (Grossman and Salas, 2011, p 104). A model for the process of transfer, have been presented by Baldwin and Ford and later adopted by Grossman and Salas (2011). It includes training inputs, outputs and conditions of transfer, see Figure 1.



**Figure 1: Transfer of training (Grossman and Salas, 2011, p. 106)**

In this model training input is organized in three main categories and these are trainee characteristics, training design and work environment. These will be crucial for learning, retention, generalization and maintenance of targeted skills (Grossman and Salas, 2011). We will give an explanation of these three inputs next.

### 2.4.1 Trainee characteristics

Cognitive ability, self-efficacy, motivation and perceived utility of training are traits that are shown to have consistent and strongest relationship with transfer (Grossman and Salas, 2011, p. 107). If a trainee have high cognitive ability, the more likely it is that the process of transfer is more successful (Grossman and Salas, 2011, p. 107). This will play a crucial role in the organizations training programs. Self-efficacy can be described as the confidence the trainees will have in their ability to solve problems and acquire targeted skills (Grossman and Salas, 2011). If a person has high self-efficacy, they are more willing towards tutoring others (Roscoe and Chi, 2007) In order for the trainees to transfer the training into practice, they must believe in their own qualifications.

In addition to believing in themselves, it is crucial that they have high motivation and that this motivation remains throughout the training. When trainees are motivated and believe that they are capable of learning and that the effort to learn will change their performance, transfer of training can take place (Grossman and Salas, 2011, p. 108). If a mentor has high efficacy, they are more likely to have higher motivation, and they may feel that they are more capable to generate deeper elaborations and knowledge (Roscoe and Chi, 2007).

An essential part of our thesis is to motivate users to become mentors that encourage other users. It is therefore important to think of what motivates a person that goes through our e-learning courses. The job facet theory is a motivation theory that we will use. This theory argues that “jobs could be redesigned to make them intrinsically satisfying and thus motivating” (Furnham, 2005, p. 313). It further suggests that motivation is a multiplication function of five job dimensions as seen in Figure 2:

$$MPS = \frac{\text{Skill variety} + \text{task identity} + \text{task significance}}{3} \times \text{autonomy} \times \text{feedback}$$

where MPS= the motivational score. There are three critical psychological states that have an impact on motivation and these are experienced meaningfulness, experienced responsibility and knowledge of results. These states can be affected by the job and five core job dimensions, and these are: skill variety, task identity, task significance, autonomy and feedback. This can be seen in Figure 2.

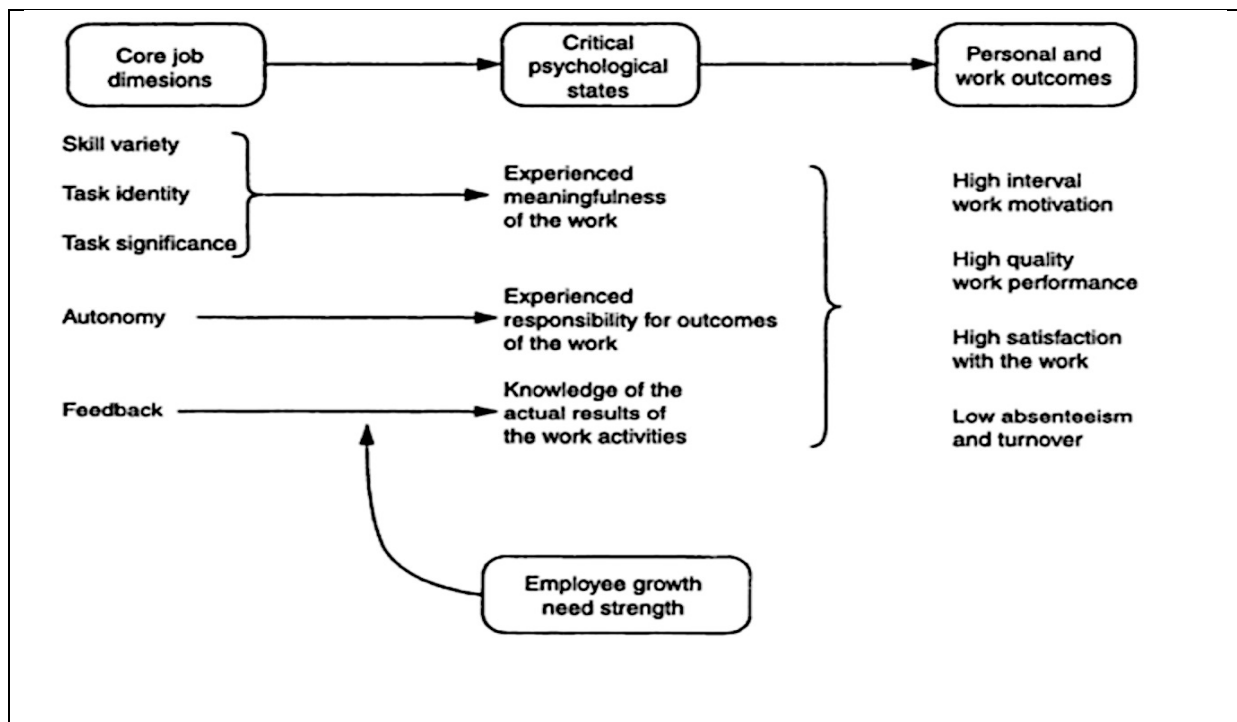


Figure 2: Motivation (Furnham, 2005, p. 313)

As one can see from the figure, experienced meaningfulness is affected by three of five dimensions and we will keep this in mind when designing the e-learning courses.

The trainees that perceive their training as useful and valuable will more likely apply the new gained competencies. In order for transfer of training to take place, the trainees must recognize that there is a need for improving the performance in the workplace, and that these new skills will improve this.

### **2.4.2 Training design**

How training programs is designed have a significant impact on learning and how the transfer process takes place. Grossman and Salas mention three traits that are highlighted and these are behaviour modelling, error management and realistic training environment (Grossman and Salas, 2011).

The first, behaviour modelling can be described as an effective training strategy and it incorporates different training strategies such as explanations of behaviours to be learned, feedback, opportunities to practice the learned skills and social reinforcement. A meta-analysis done by Taylor et al. (2005 referenced in Grossman and Salas, 2011, p. 111) concludes that behaviour modelling is best transferred when positive and negative models are provided, when trainees generate their own scenarios in practice and set their own goal. In addition rewards and sanctions should be instituted in the work environment (Grossman and Salas, 2011). Research has suggested that behaviour modelling is of particular importance for transfer of training (Grossman and Salas, 2011, p. 111).

Error management allows trainees to make errors and providing error management instructions have emerged as effective ways to facilitate the proper use of targeted knowledge and skills on the workplace. This allows the trainees to anticipate what can go wrong and equips them to handle potential problems. Highlighting negative outcomes that can occur if training is not transferred. The last trait in training design is realistic training environment. Training skills are more likely to transfer into the job setting if they are learned and practiced in the work environment. A way to do this is on-the-job training, where the training takes place in the actual work environment.

In addition, Blum and Naylor (1968, referenced in Furnham, 2005, p. 442) have provided a checklist for how to enhance the training process, and this can be seen in Figure 3.

1. Motivation is not only a desirable but often a necessary accompaniment of learning.
2. The number of units or lessons to teach most effectively must be a considered judgement; too often it is arbitrarily and artificially set.
3. The amount to be learned in any one unit must be planned. For optimal learning, the unit should not be too large and complex, or too simple.
4. Any training is practically never comprehensive or exhaustive. The amount to be learned has to be related to the desired job performance. For example, a person doesn't need to know how a motor operates to drive a car.
5. The task to be performed should be demonstrated.
6. The demonstration must be immediately followed by the doing on the part of the learner.
7. A discussion-and-question session should follow the doing, to clear up any misconceptions on the part of the learner between the explanation of why and the demonstration of how.
8. Ample and adequate practice opportunity should be encouraged. Some learners tend to overestimate their performance, and erroneously and prematurely believe that the task has really been learned.
9. Observable progress during practice goes a long way towards encouraging a sufficient amount of practice. Plotting the learning curve wherever practical is encouraged.
10. A summary and review of the entire learning process should be made by the learner, with the teacher available for last-minute pointers and for establishing that the task has been learned according to performance that meets the criterion or standard.

**Figure 3: Checklist training process (Furnham, 2005, p. 442)**

With this checklist in mind there is important to do a training needs assessment before making the actual training programme. This assessment should according to Berry (1998, referenced in Furnham, 2005)

Enable the trainer to decide on various fundamental factors: the number of practice sessions required, the length and intensity of those sessions and the nature of the

content [...] The analysis should also indicate salient individual differences among the trainees, such as their abilities, knowledge and motivation (p. 461).

Goldstein (1986, referenced in Furnham, 2005, p. 461) presented that a training needs assessment have three facets and these are organisational analysis, job/task analysis and person analysis. In the organisational analysis the focus is on what and where the training and development is needed in the organization. This can be explored through climate indexes, management requests and exit interviews. In the job/task analysis the goal is to find out more about the specific tasks that a user needs training in. Like Furnham (2005) states “once the skills, tasks and jobs have been carefully specified they may be trained” (p. 461). This can be found through job descriptions and performance data. The last facet is person analysis and this is about finding the individual and group needs. This can be done through interviews, questionnaires, tests and diaries.

After this assessment the design process can start. An essential area for attention when designing a training programme for optimal learning effect, are the users transfer of training.

### **2.4.3 Work environment**

Work environment has impact on transfer outcomes. The effectiveness of training is dependent on the trainee’s ability to use their new knowledge on-the-job. Here Grossman and Salas (2011) list four traits that are of interest and these are transfer climate, support, opportunity to perform and follow-up.

An observable or perceived situation in organizations that inhibit or facilitate the use of learned skills is a part of the transfer climate. Cues can be used to prompt trainees to use their new skills, and we can distinguish between two such cues, situational cues and consequences. Situational cues can include manager goals, peer support, equipment availability and opportunity to practice the trained skills (Grossman and Salas, 2011, p. 112). Consequences can consist of punishment and positive or negative feedback. Optimally a combination of cues and consequences can influence how well the new skills and training can be transferred into the workplace.

In order for training to be transferred, support is one of the prominent factors. This applies to both supports from the supervisor and other peers. The trainees should set goals for the

training and for the future to apply new knowledge and research has indicated that goals in combination with feedback enhance the motivation and the performance (Taylor et al., 2005 referenced in Grossman and Salas, 2011, p 113). The resources and the opportunities to apply the new acquired skills and abilities to the workplace. The lack of resources sets limit to the learning process and so will time constraints. Formal training should be followed by additional learning opportunities and the time period directly after the training gives opportunity to enhance and strengthen learning. Trainees should reflect upon their training experience and follow this up with practice and discussion. Research has also shown that feedback in this time period supports learning (Grossman and Salas, 2011).





## 3 Study context

### 3.1 Malawi

Malawi is located in Southern Africa and borders to Mozambique, Tanzania and Zambia. It is a landlocked country and has a sub tropical climate with three seasons. The land area is 118,484 km and has a population of 16,3 million people (United Nations Development Programme, 2015b). The country is divided in three regions, the southern, central and northern region. Within these three regions, the country is further divided into 29 districts. These districts vary in size, population, socio-economic factors and depending on these factors it can be difficult for the residents to travel to the District Hospital in rural areas. An example of this was when we had a field trip to one rural area in the Southern Region. Using Google maps, the travel time was estimated to be one hour and six minutes. In reality we used five hours one way, driving on a road that at times did not exist and ended up as rivers to be crossed.

Malawi is one of Africa's most densely populated countries. In 2008 the population density was estimated to be 139 persons per km<sup>2</sup>, and in the southern region of Malawi the population density was estimated to be 184 persons per km<sup>2</sup> (MoH, 2011). The capital city is Lilongwe, which is located in the central region. Other large towns are Blantyre, Zomba and Mzuzu. The official language in Malawi is English and the common language is Chichewa.

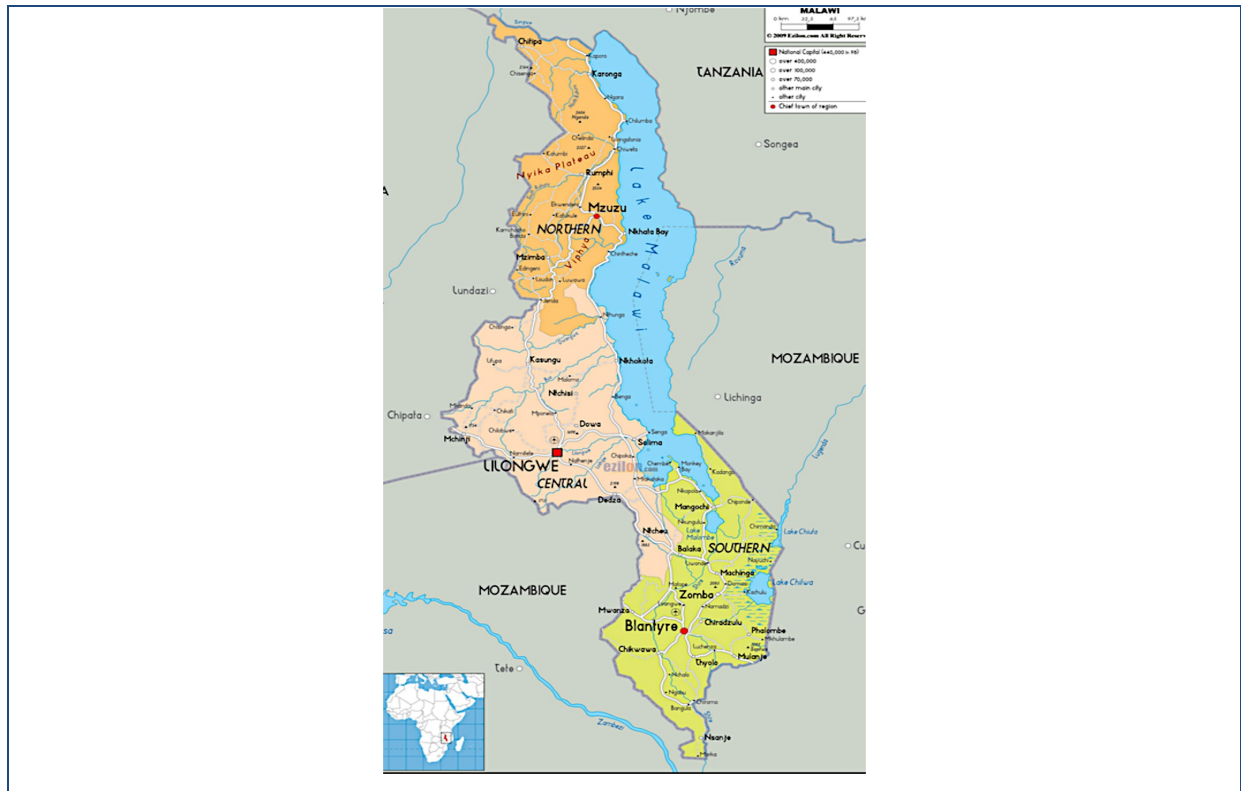


Figure 4: Malawi country profile

### 3.1.1 Health status

The human development index (HDI) is a summary measure for 187 countries. It assesses the long-term progress in three basic dimensions of human development, which involves a long and healthy life, access to knowledge and a decent standard of living. Malawi is ranked as 174th on this list, whereas Norway is ranked as nr 1.

The life expectancy at birth is 55,3 years in Malawi, and the country suffers of high child mortality. Child mortality under the age of five is seventy-one deaths per thousand. In contrast Norway has three deaths per thousand, under the age of five (United Nations Development Programme, 2015a). Malawi has a high prevalence of communicable diseases such as malaria, tuberculosis, sexually transmitted infections and HIV/AIDS. The prevalence for men and women aged 15-49 who is infected with HIV/AIDS is 10.8 % (United Nations Development Programme, 2015b).

### 3.1.2 Malawi health care delivery system

The Ministry of Health (MoH) in Malawi is responsible for the overall developing policies, planning strategies and to ensure that all providers follow the national policies and standards. According to the Constitution of the Republic of Malawi the state is obliged to provide

adequate health care that commensurate with the Malawians needs and to international standards of health care (MoH, 2011). This means that the Malawians are guaranteed free health care within the resources available. The health care service is delivered both by public and private sectors in Malawi. The public sector includes all the facilities that MoH manages, while the private sector consists of private-for-profit and private not-for-profit. The Christian Health Association of Malawi (CHAM) is a private not-for-profit organisation and provides for about 37 % of the health service delivery in Malawi. It has a catchment area of about four million peoples, and has services mostly in the rural and hard to reach areas. The public sector offer their services free of charge, while the private sector (private-for-profit) charge their patients with a user fee for their services.

There are three levels of care in Malawi, which consist of a primary, secondary and tertiary level of care. The primary level consists of rural hospitals, dispensaries, maternity facilities, health centres and so on. The secondary level consists mainly of district hospitals, and each district should have one. They are a referral facility for the primary level of care. Often these hospitals also deliver in-patient and out - patient services to the local community (MOH, 2011).

The tertiary level of care consists of central hospitals that provide referral health services for their regions. These hospitals offer specialised services, such as gynaecology. There are currently four such hospitals in Malawi today, located in Blantyre, Lilongwe, Mzuzu and Zomba (MoH, 2011). These different levels of health care are linked to each other through a referral system.

### **3.1.3 Malawi health information system**

In each district there is a District Health Office (DHO), and these are often located at the district hospitals or nearby. They are responsible for the coordination of health services and programs delivered at district level, and supervise both the hospital and the government facilities in the district. District Health Managers such as the District Health Officer or the District Health Nurse use HMIS data for making decisions and planning. There is one HMIS officer who is in charge of collecting, organizing, control and following up the HMIS related activities (Hamre, 2007). The HMIS officers collaborate closely with clerks, which have HMIS responsibilities as their primary work. The clerks have different background; some

may have statistical background, while others have secondary school. In each DHO there are 0 – 5 clerks. There are also Programme Coordinators of specific health programs such as HIV/AIDS or Family Planning and there is 15 – 25 such coordinators in each district. They often use their own program specific forms and these contain details on their specific area of interest. The reports are supposed to be entered into DHIS 2, but this varies from district to districts. It can be several reasons for this, e.g. that they are supported by other funding organisations and might have their own systems. Today Malawi is using DHIS 2, version 2.0.

## **3.2 Health information system**

A health information system (HIS) should collect information so that managers can make decisions for the health system. It is defined as “a set of components and procedures organized with the objective of generating information which will improve health care management decisions at all levels of the health system” (Lippeveld and Sauerborn, 2000, p. 3).

HIS can have multiple meanings for the people working within health, depending on which role one has in the system. For a health manager it means to aggregate data in a health management information system and for nurses or doctors it means data related to the patients they are treating. Lippeveld and Sauerborn (2000) discuss in the article that the use of the term “health management information systems” can be somewhat confusing and misleading. This because it may suggest that there are different information systems for different functions. They define all these subsystems as a unified health system. Figure 5 can be used to illustrate the relationship between the health information system, and the health system at general. As one can see from the figure, the health care level is divided in three levels of care, like it is in Malawi. Each of the levels has their own decisions to make.

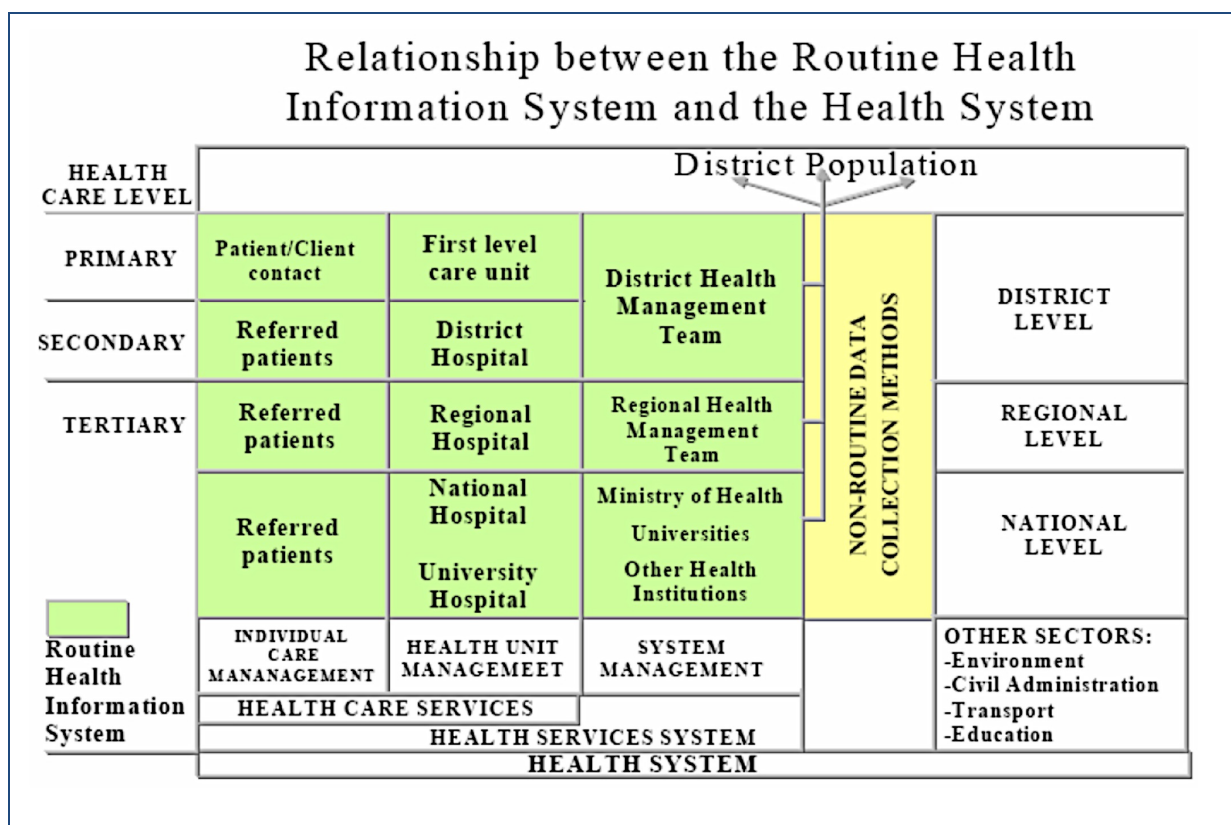


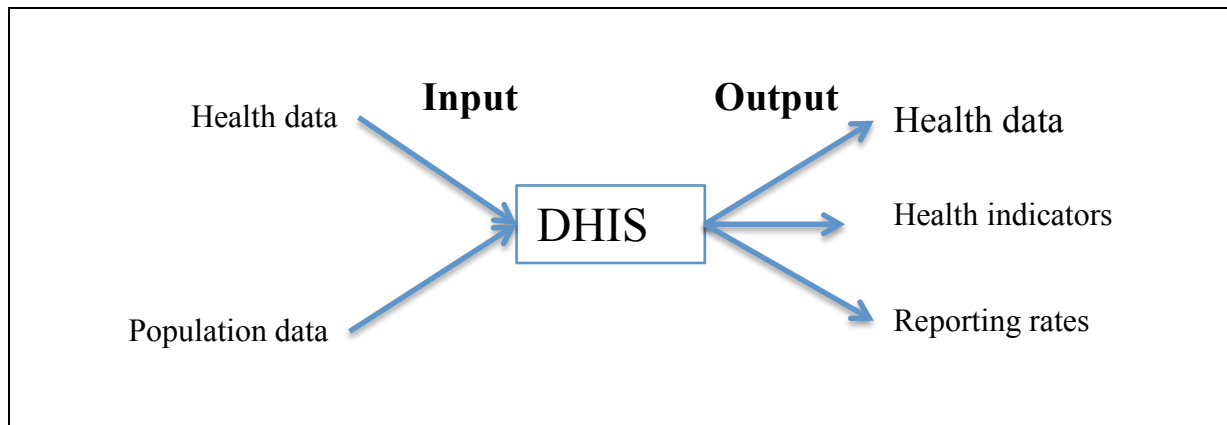
Figure 5: Relationship between HIS and the health system (Lippeveld, 2001, p. 16)

### 3.3 DHIS

DHIS stands for District Health Information Systems and is a database tool for collecting, storing and managing aggregated data for management and analysis. It started out as the HISP project in South Africa in 1996. This started after the political changes in South Africa and the fall of the apartheid. The South African health system was highly fragmented in health programmes, and the aim was to develop a district health information system to support the national health plan based on decentralizing health districts (Braa and Hedberg, 2002). HISP is an on-going global action research project that uses a participatory design approach. It is managed and coordinated by the Department of Informatics at the University of Oslo, and it is collaboration with several other organizations such as USAID and NORAD. One of HISP Norway's focus areas is to develop and govern DHIS 2, and today DHIS 2 is the preferred health information system in over 30 countries (DHIS2, 2015).

DHIS 2 is an open source and free software package for hierarchical organisations. It enables aggregation of statistical data and tracking cases. The software runs through a web browser and data is stored in a national or central server. It consists of two parts, which is data

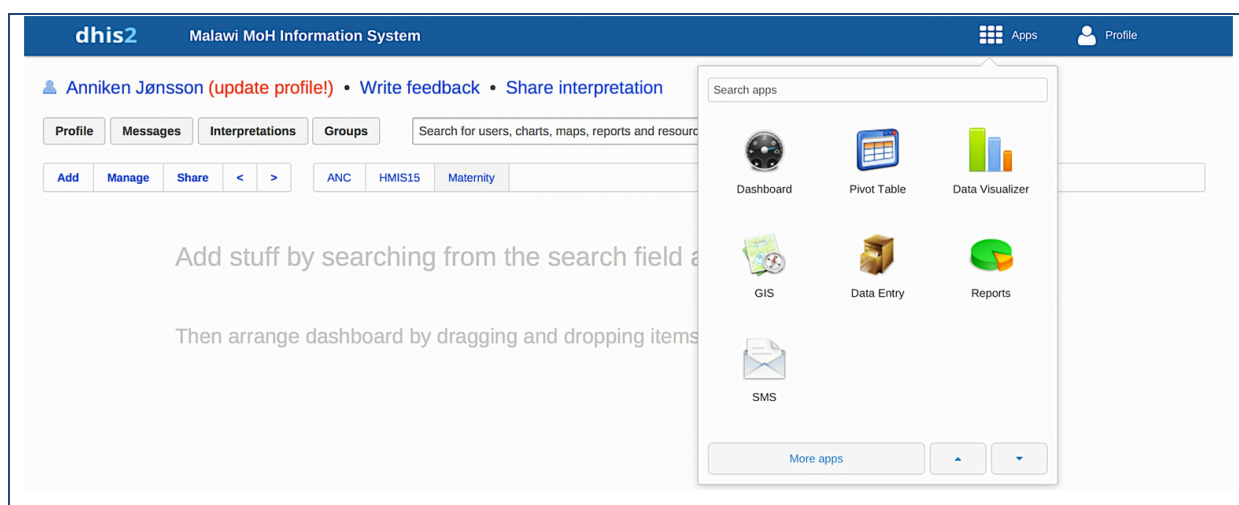
collection and analysis at facility level and the DHIS software, which process the data (Garrib et al., 2008). Data collected at the facilities is usually paper-based systems such as tally sheets, registers or monthly data collection forms (Garrib et al., 2008). This is essential data based on indicators. After data has been collected, it is usually sent to the district level where it is entered into the software and later analysed. Figure 6 gives an overview of how input and output are managed through the system.



**Figure 6: Input and Output in DHIS 2**

### 3.3.1 DHIS 2 Malawi

The functionality of DHIS 2 is organised into apps, and during installation these can be added or subtracted, hence one can tailor the system according to needs. Note that these apps differ from what people install on smartphones in three ways. The DHIS apps are parts of the larger database system, they are stored in the web server, and they can run in browsers in any device. In this section we will introduce the main functions DHIS 2 has in Malawi.



**Figure 7: Front page DHIS 2 Malawi**

## **Dashboard**

The Dashboard gives the user quick access to different kinds of analytical objects, such as maps, charts, reports and tables. A user can create several Dashboards and navigate between these. When a user logs into the system, Dashboard is the first page that will appear. The Dashboards a user creates is personal, but can be shared with other users or groups if wanted.

## **Pivot Table**

This module enables the users to create Pivot Tables using all available data dimensions in DHIS 2. It is a data summarization tool that can arrange data according to its dimensions.

## **Data Visualizer**

Enables users to create data analysis and visualizations through charts. By selecting indicators, data elements, periods and organisation units gives a visualization of the selected data.

## **GIS**

The Geographical Interface System (GIS) gives users the opportunity to display data in maps.

## **Data Entry**

In this module gathered data is manually entered into the DHIS 2 database. It is usually organised by organisation unit, a period and a set of data elements and the data set often corresponds to a paper-based data collection tool.

## **Reports**

Enables the users to select a range of reporting alternatives such as standard reports, data set reports, reporting rate summary and organisation unit distribution reports to display data. These reports can be downloaded as excel forms, PDF, XML or CVC files.

## **SMS**

DHIS 2 provides the opportunity to SMS connection, which enables the system to alert users, register patients and report data through SMS.

### 3.3.2 User documentation and learning material in DHIS 2

In the software you can find learning materials in two different places. Under the Reports app one can Resources. Here you can find help material and among these two user manuals. One is called “End-users” and another “Superusers”. These user manuals are PDF files that can be opened in the browser or be downloaded. The “End user manual” consists of 54 pages on how to use the software and its different functions. The “Super user manual” on the other hand consists of 409 pages and goes in depth on how to set up the system and is targeting administrative and technical staff. The second place to find learning material is the “Help” icon that can be found under the profile tab in the top menu. It contains a side bar with different topics and short explanations, see Figure 8. The explanations are less detailed than the manuals, and does not contain any screen shots, just written explanations.

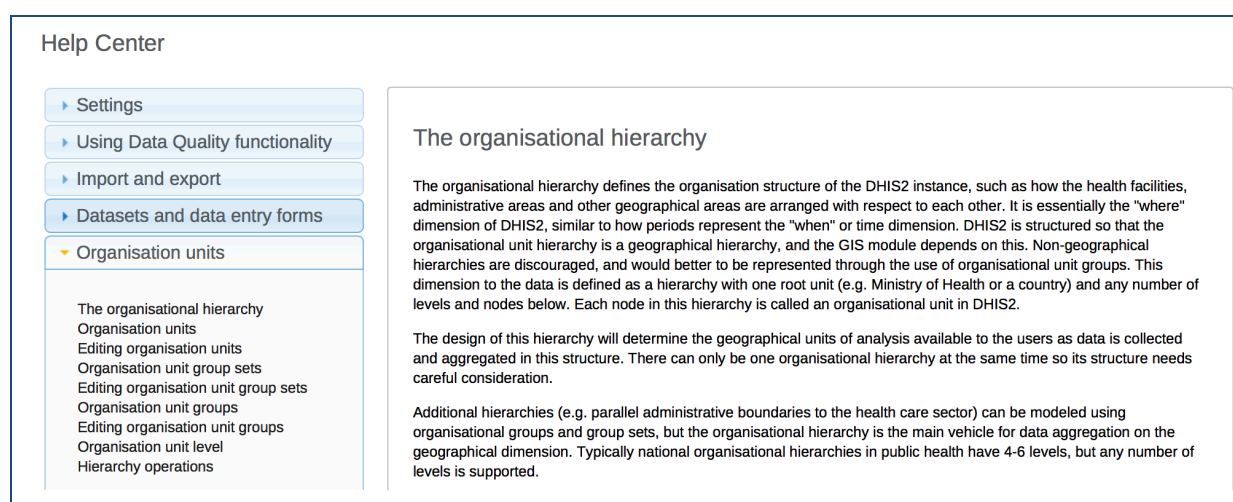


Figure 8: Help Center, DHIS 2 Malawi



## **4 Research Methodology**

In this chapter we will present the research approach and methods that we have used in this thesis. The purpose of our study was to develop the content to an e-learning course and test this in Malawi. Because of this our data collection was divided into two trips to Malawi. During the first round our aim was exploratory and to learn more about what kind of training the users have, and how they use the system. The second round of data collection was evaluating, and our aim was to test and observe the use and content of the training material we had developed.

### **4.1 Approach**

Research approaches can be classified into qualitative and quantitative research (Myers, living version). Quantitative research is concerned with systematic investigation of a phenomenon and what is measurable. Methods used in this research field are survey methods, questionnaires and laboratory experiments among others (Myers, living version). Qualitative research on the other hand enables a researcher to study the social and cultural aspects of phenomena (Myers, living version). Some of the methodologies used within this research field are action research, case studies, ethnography, and common data collection methods are interviews, observations, audio and video among others. We have chosen to use a combination of both qualitative and quantitative techniques in our research project and by doing so we can triangulate (Myers, living version).

### **4.2 Paradigm**

All research is based on philosophical assumptions (Myers, living version) and our research lies within the interpretive research field. This paradigm assumes that the reality is socially constructed through language, consciousness and shared meanings (Myers, living version). It focuses on the complexity of human sense making and to understand the context of the information system. We are trying to understand a phenomenon's relation to how users learn and how they can be cultivated to become mentors.

### 4.3 Action Research and Quasi experiment

Action research (AR) is a qualitative method and a strategy of inquiry. It is based on collaboration between the researcher and a group of people who are experiencing a problem. The researcher helps to identify what this problem is, and comes up with a possible solution to this. It is an iterative cycle where the first step is diagnosing the problem. Then action is planned and taken, and afterwards evaluated. The last stage is specifying learning, although this usually is an on going process (Baskerville, 1999).

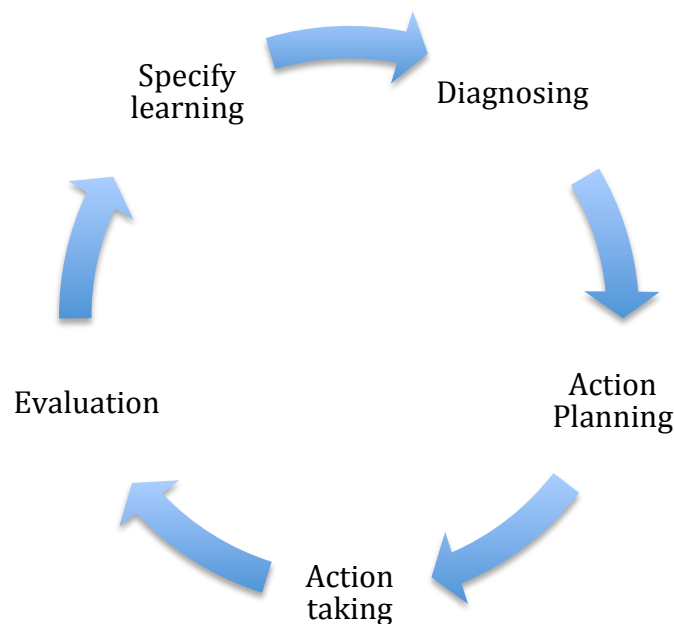


Figure 9: Action research cycle

Our research project is not an AR project on its own, but a part of one. This is because our project will not do an intervention or solve a problem before it is implemented in DHIS 2, which is out of range for our thesis. Our aim was to learn more about the course material and how this should be designed, not to do an intervention. Therefore we have conducted a qualitative quasi experiment. The reason for why we conducted a quasi experiment and not a field experiment are because of the requirements of participants and randomization in the field experiment. Due to resources and settings this research was conducted in, we did not have the opportunity to randomize the participants. The advantage of using this method instead of a laboratory experiment is that we can explore the real life setting as well (Braa and Vidgen, 1999).

## **4.4 Data Collection Methods**

### **4.4.1 Questionnaire**

In order to gather more data about opinions of training and mentoring in the DHIS community we produced a questionnaire. This was done before we went to Malawi the first time. Questionnaires are a good method to get answers from a large group of people and can be used on its own or in conjunction with other data collecting methods (Preece, Rogers and Sharp, 2009, p. 309). The questions in a questionnaire can be open and closed, depending what you aim to find out. We used a combination of these in the questionnaire we sent out and in total there were 31 questions. The closed questions used Likert scales in order to measure beliefs and opinions, see Appendix B. The questionnaire was web—based and a link was sent to the global DHIS user team e-mail list, having members in six continents and most of them living in low and/or middle income countries (LMIC). The list had a total of 716 members and a reminder was sent out three times. After the questionnaire was closed, one of the participants was drawn to win a prize of \$100.

### **4.4.2 Interviews**

Interviews can be divided into three groups, and these are structured, semi-structured and unstructured interviews (Crang and Cook, 2007, p. 62). In structured interviews the procedures are strict, and there is no room for elaboration on answers. Semi-structured interviews are divided into topics the researcher wants to discuss, and there are few questions. This leaves room for elaboration on the answers, and the researcher can get a discussion with the interviewee. The third and last is an unstructured interview that is completely open and there are no planned topics. These kind of interviews are often exploratory and more conversations around a particular theme (Preece, Rogers and Sharp, 2009, p. 298). This kind of interview is beneficial when you want to generate rich data, and there is no need to replicate the process with other participants (Preece, Rogers and Sharp, 2009). In order to gather the information we wanted, we decided to use the semi-structured interviews in both of our data collection periods. In this way we could prepare questions and topics regarding the information we wanted, and still have the opportunity to elaborate on answers the participant gave, see interview guide in Appendix C.

#### **4.4.3 Observations**

It is not always easy for people to explain what they do, or why they do as they do. So in order to fill in the gaps, the details and the nuances, observations can be used (Preece, Rogers and Sharp, 2009). We can distinguish between two types of observation, participate and passive observation and these can take place in natural environments or in a laboratory setting. In a participant observation the researcher will participate in the social process that he/she studies, while in a passive observation the researcher will observe from a distance and not participate in any way. We used both types of observation through our data collection period, and this will be described later in the chapter.

#### **4.4.4 Field Notes**

Data was collected through interviews and training sessions with observations, and this was done through note taking. During our first round of data collection, in the exploration cycle, we used only field notes. During the second round of data collection, in the evaluation cycle, we supplemented our notes with audio recording. After each session our field notes were transcribed and discussed.

#### **4.4.5 Audio**

Audio recording can be a good method in order to capture all details, and during observation it allows the observers to be more mobile and flexible (Preece, Rogers and Sharp, 2009). In order to use audio recording it is important that the participants give their consent, and one should bear in mind that it can influence how the participant behaves. During our first round of data collection, in the exploration cycle, we experienced that it was difficult to capture all the details. Therefore, audio recording was used during the evaluation cycle. Before each session, the participant was asked if they approved audio recording and if they were comfortable with this. An explanation of how it would be used and stored was given and after the sessions, the audio recordings were stored on an external disk that only we had access to. Transcription of the audio records was organized by summaries and themes.

## 4.5 Cycles of data collection

As mentioned earlier in this chapter, data collection was divided into two cycles, exploration and evaluation. The cycles followed four steps in an iterative cycle, see Figure 10.

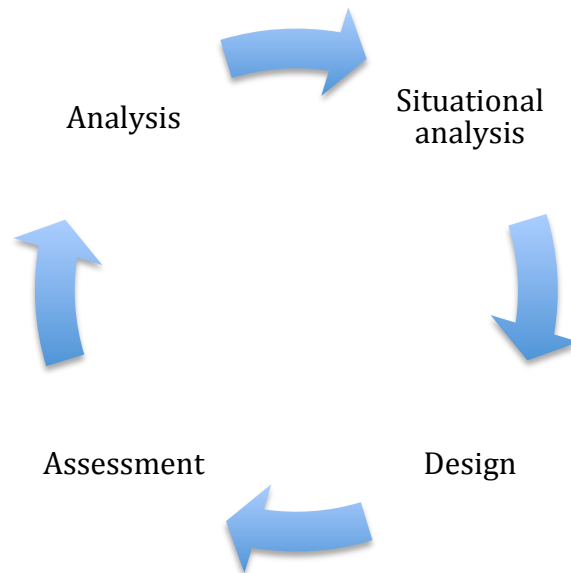


Figure 10: Exploration and Evaluation cycle

### 4.5.1 Situational analysis

The situational analysis consisted of a data collection process to analyse the organizations environment. This phase resembles the diagnostic stage in the action research cycle, and we wanted to gain an overall impression of how the District Health Offices use DHIS 2, and what kind of training they have had.

### 4.5.2 Design

In the design processes we made low fidelity prototypes of the course material intended for the application. The prototypes are low fidelity since we tested paper-versions of our material, and not web based or electronically versions.

### 4.5.3 Assessment

In the assessment phase we will present our findings from the field trips. We have also done an assessment of the learning material that is the designed to evaluate the effectiveness of the training modules, in order to make necessary improvements. To do this we used Kirkpatrick's

four levels of evaluating, which consists of reaction, learning, behaviour and result, see Figure 11.

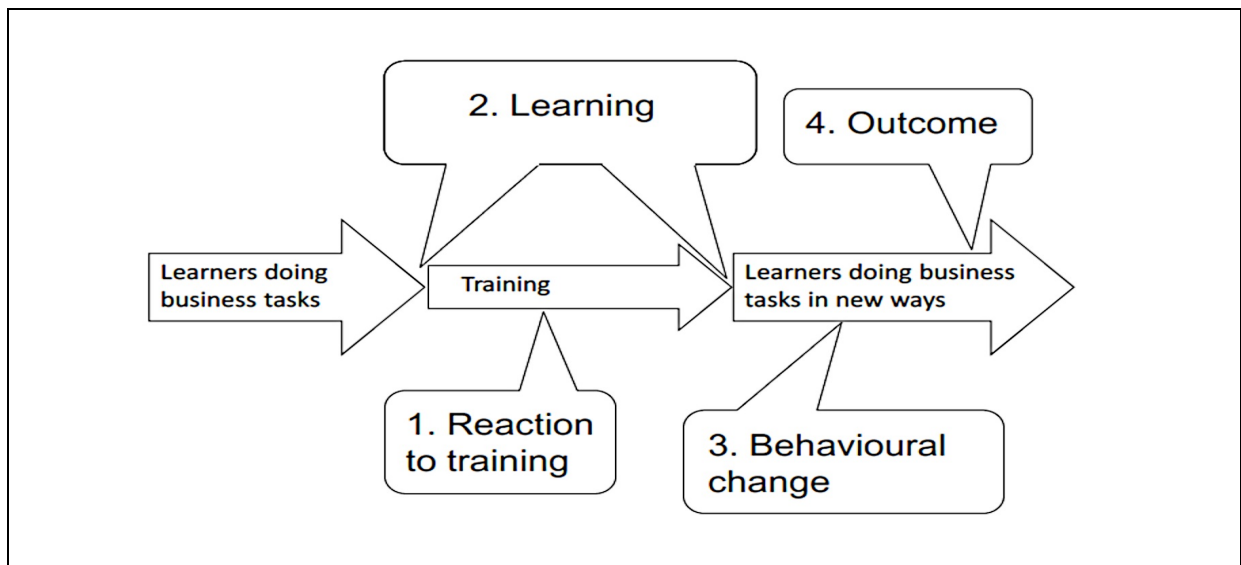


Figure 11: Kirkpatrick's four levels of evaluating (Kaasbøll, 2015, p. 144)

The first level is reaction, and this is the participant's opinion of the course and usually it is verbal feedback during the training course. The aim is that the participant feels that the training is valuable and useful in order for them to do learn new tasks. It is also an important step in order to understand how well the course material is received and useful to identify what potentially missing in the course.

The second level, learning, is an assessment of what the participant has learned throughout the course. Normally this is evaluated through a pre- and post test, and by doing this kind of evaluation we can see the difference between the two levels and see if knowledge is increased because of training. The third level is behaviour and it investigates if the participants use IT back at work or in other business (Kaasbøll, 2015). This usually means visiting the participants after the training sessions to see if they use IT in a different way from what they were doing before. The aim is to see if the participant has applied the information given during training. The fourth and last level in Kirkpatrick's evaluation model is result. This is a measurement of the final results of the training, and if there are changes in the organisational performance. This can be costly and time consuming, and the evaluation should be done based on the objectives of the training.

#### **4.5.4 Analysis**

The last step in the exploration and evaluation cycle is analysis. This was an on-going process of documenting and summing up what learning outcomes and findings the cycle has had. This was also the starting point for the new cycle. After the two cycles we had gathered quantitative and qualitative data, and we will give a short explanation of how these were analysed.

##### **Quantitative data**

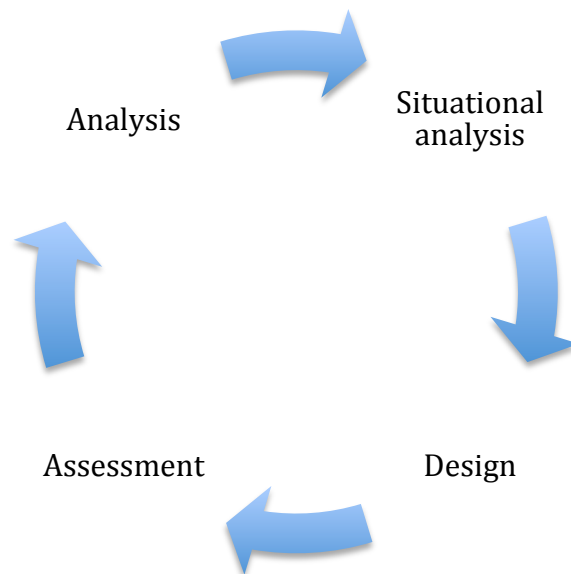
After gathering quantitative and qualitative data it needs to be analysed, and there is a difference in the way that this is done. It is easier to make a distinction between data gathering and data analysis when dealing with quantitative data. This distinction is not so clear when it comes to qualitative data and this process is often closely linked and occurs parallel with each other (Myers, living version). The first step in analysing the quantitative data was to clean the data in case some had misunderstood a question. After this we wanted to find out where the tendency in the data where, and used the measure mean. Wilcoxon's signed-rank test were also used to test the differences between high and low Likert scale responses, since no normal distribution was assumed.

##### **Qualitative data**

The first step we did was to gain an overall impression of the gathered data and searched for patterns and deviations in both interviews and observations. We searched in the answers from the interviews and the behaviour of users in the observations to see if there were themes that were reoccurring. This approach resembles the analytical method called thematic analysis outlined by Braun and Clarke (2008). The advantages of using this method is that it gives flexibility and can generate unanticipated insights in the data (Braun and Clarke, 2008, p. 97).

Since our research is placed under an interpretive paradigm, it was also natural to apply a hermeneutic mode of analysis as well. This is a way of understanding the empirical data gathered and the aim was to make sense of the whole picture (Myers, living version). That means that we had to look at the organisation, the relationship among peers, the system and how this makes sense.

## 4.6 Exploration cycle



**Figure 12: Exploration cycle**

The situational analysis had two phases in the exploration cycle. The first phase consisted of the questionnaire sent out to the DHIS community and reading literature. We also had informal conversations with Mr Chris Moyo, the Deputy Director for the Center of Monitoring and Evaluation, Ministry of Health of Malawi. These conversations took place in Oslo when Mr Moyo was visiting the University of Oslo. Based on what we learnt through the first phase we designed a basic module for the Dashboard and Visualizer function in DHIS, and an advanced module for the Visualizer. The basic module was developed for exploration and consisted of a step-by-step instruction on how to carry out a task in the system. The draft of the advanced module consisted of problem solving methods occurring in the Visualizer app.

The second phase of the situational analysis was the interviews conducted in Malawi. During our first visit in Malawi, we visited seven districts in the central and southern region. These districts were chosen because the reporting rate was good in some of the districts, and poor in the others. We wanted to see if there was a reason for this, and what this reason might be. We interviewed nine persons in total, and these were a combination of HMIS officers, Program Coordinators and clerks, see Table 2 for more details. Before our trip we had initiated contact with the different districts by email. In this email we informed that we were coming to the districts in a specific time period and that we would like to have a meeting with



HMIS officer, clerks and Program Coordinators. Due to busy time schedules at the District Health offices we did not receive answers from all the participants. Despite this we went to visit in hope to meet some participants that would have the time to be interviewed.

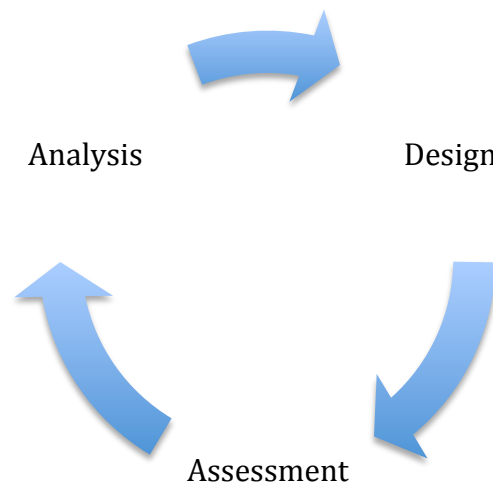
Period	Activity/Who
11.06.2014	Interview with Program Coordinator and clerk
12.06.2014	Interview with HMIS officer
13.06.2014	Interview with Program Coordinator and clerk
16.06.2014	Interview with HMIS officer Program Coordinator
17.06.2014	Interview with Program Coordinator
18.06.2014	Interview with HMIS officer
19.06.2014	Interview with HMIS officer

**Table 2: List of interviews June**

The interviews were conducted in the participant's office or in a meeting room at the hospital, see Appendix C for interview guide. During the interviews we focused on their background, what kind of training they have had before and how often they use the system. Each interview started with an explanation of why we were there and our aim with the interview. We then had a warm-up session, where the questions aimed at making the interviewee feeling comfortable. During the interviews we had a dividing of roles between us as researchers. One was in charge of conducting the interview, while the other had focus on taking notes. In this way the interviewer could focus on the conversation and elaborate on the answers, instead of being distracted by taking notes. At the end of each interview we introduced an example of the basic module and a draft of an advanced module. By introducing these modules we got feedback from the interviewee on how this material could work in real life and in the everyday tasks. It was also a method of probing, which means we used the modules as a device for getting more information (Preece, Rogers and Sharp, 2009, p. 300).

After this we did an assessment of the design using Kirkpatrick. On this stage in our research we could evaluate the reactions to the course modules that we had designed. The aim was to see what kind of reaction this kind of training material would give, and if it were valuable to learn new tasks in the system.

## 4.7 Evaluation cycle



**Figure 13: Evaluation cycle**

As seen in Figure 13, the evaluation cycle consists of three phases instead of four. This is because the situational analysis was conducted during the analysis phase in the exploration cycle. Based on the findings from the exploration cycle, we decided to design the course material in two levels, basic user level and mentor level. The basic user material consists of one module per topic and for each topic there is a mentor module. During our second trip to Malawi, our main goal was to observe the participants going through the courses we had designed and developed. During this data collection period we visited four districts in the southern region. These districts were chosen because of convenience and we could visit each of them by a day trip from our base in Blantyre. This reduced travel time since we had to visit each district twice during two weeks. To initiate contact an email was sent out to the HMIS officers in the four districts and we received answer from one district. Contact was then established by visiting the District Health Offices.

The training material was tested in two rounds. During the first round we went through the basic user courses with an HMIS officer or a clerk, dependent on whom we established contact with. In the second round this HMIS officer or clerk would mentor a colleague to test the mentor courses, see Table 3. After mentoring others, the mentor received a diploma, which was accredited by us as researchers. In total we conducted four training sessions during the first week, and three sessions during the second week. This was because one of the districts did not have Internet connection, and we could not conduct a session. After each session we asked the mentees of their opinions on the course. Before visiting the four selected districts, we activated the min/max validation rules in DHIS 2, for more explanation on min/max, see Appendix E. We activated these since there is a module covering this in both the basic user course and the mentor course. Since this function is not activated nationally, we had to activate them in these districts so we could carry out the training sessions.

Period	Activity/Who
24.11.2014	Test of basic user course with HMIS officer
25.11.2014	Test of basic user course with clerk
26.11.2014	Test of basic user course with clerk
27.11.2014	Test of basic user course with HMIS officer
01.12.2014	Test of mentor course with clerk
02.12.2014	Test of mentor course with clerk
03.12.2014	Test of mentor course with HMIS officer

**Table 3: List of training session November / December**

### **Week one**

During the first week of training, our main goal was to observe while the user went through the basic user course modules. Since some of the topics were new to the participant we functioned as mentors for the participant and it became a participate observation. This method is similar to the “question-asking protocol” first introduced by Kato in 1986 (Grossman et al., 2009). The idea in this method is that an expert/mentor sits beside the participant and answers questions. In these sessions a division of roles was made between us as researchers. One was in charge for mentoring the participant and guiding him/her through the courses, while the other was in charge of taking notes and making sure that the audio record device was recording. The one who where mentoring were sitting next to the

participant, while the other were sitting in the back. Each session lasted for approximately two hours and their task to the next session was to read through the mentor course, and make the necessary preparations in order to mentor others. This was done since the user courses were time consuming, and the participants had other tasks to tend to. During these sessions we conducted evaluation on two levels according to Kirkpatrick's four levels and these were reaction and learning. When we went through the course material with the participant, we got their verbal reaction to the topics and the content both during and after the sessions.

### **Week two**

During the mentor sessions in the second week, we as researchers would not participate in the sessions in any way. The mentor from the first week went through the courses with a colleague and the aim of these sessions was to observe how the mentor conducted the sessions, and how the mentor courses were used. The sessions lasted from one hour, up to three hours depending on the mentees skills in IT. This time we as researchers were sitting in the background, and did not participate in the sessions. If the mentor had questions regarding the system or the functions, we answered these. During this week we could also evaluate the reactions to the mentor courses and learning. We could do an assessment of what the mentor had learned through the courses, and look for differences from the first week to the second week.

## **4.8 Reliability and Validation**

Reliability gives an indication for how well the methods used, can produce the same results on a separate occasion under the same conditions (Preece, Rogers and Sharp, 2009, p. 640). When conducting a lab experiment with controlled conditions it is easier to maintain higher reliability opposed to our quasi experiment with a small sample size. In addition to this we are studying behaviour and learning, which will be a subject for higher fluctuations and then again be less replicable (Lazar, Feng and Hocheiser, 2010, p. 57). Validation of qualitative data indicates if the research has used well established and documented procedures to make sure that the accuracy of findings are increased (Lazar, Feng and Hocheiser, 2010, p. 294). We used a triangulation of data collection methods in order to obtain and verify our data.

## **4.9 Constraints and ethical considerations**

A constraint with our research project is that our selection is limited. Since it was difficult to schedule appointments before our data collection started, potential participants that could have been of interest were not interviewed. The response rate to the questionnaire was also small and due to this we may have missed relevant information and data. Another possible constrain is that the interviews and the training sessions were conducted in English. The official language in Malawi is English and the common language is Chichewa. Misunderstandings due to language may have occurred, which can have lead to bias in the empirical material. Due to time constraints and resources we were not able to evaluate learning effects on the third and fourth level in Kirkpatrick's four levels of evaluation. Because of this we cannot make any conclusions regarding if our course material will have changed behaviour and measure if the training has lead to changes in the organisational performance.

In this thesis we are evaluating our own design and course material, and implications to this can be that we are not as critical as others might have been. This is something that we have been aware of throughout the process but this can have constraints on our work.

All our transcripts have excluded the participants name and other recognisable factors. In the thesis, names and districts are made anonymous to govern the participants. We will also refer to persons as he/she in order to maintain gender anonymity. During all of our visits we have tried not to conflict the participants daily duties, and when the meetings were not planes, we waited until the respondents had finished their duties or we rescheduled the meetings. Verbal consent was given from the participants before conducting interviews and training sessions with audio recording. The audio records was stored on an external disk and deleted after transcribing. The processing of personal data in this master thesis is approved by the Norwegian Social Science Data Services, see Appendix A.



# 5 Exploration cycle

In this chapter we will present the results from our questionnaire, our initial design process, the findings from our first visit to Malawi and an analysis of these findings.

## 5.1 Situational analysis - Questionnaire

In the first phase of our research a questionnaire was sent out to the on providing and receiving help in DHIS 2. The global user team e-mail list has 716 users and these are consultants, software developers and customizers and system managers. The majority of this group is from Africa and Asia, and after three reminders we received 50 answers, which is a 7 % response rate. The questionnaire had four themes with questions related to each theme. These were introduction, specific user roles, what a mentor should be able to do and how they should learn this.

### 5.1.1 Introduction phase

The first section of the questionnaire asked questions regarding the main tasks the user has in the system, and we did this in order to categorize the respondents. Further we asked if the respondent received help from others, if they are satisfied with the help they get, if they had participated in training and if they help others. Figure 14 shows us that the users are categorized in those who enter data or view the output, those who are managing an organisational unit and those who are in the team that are adapting the system or supporting users. Out of 50 respondents, 46 participants were from the last category. This means that the respondents provide more help than they receive.

#### **What is your main task concerning DHIS**

- ☐ I enter data or view the output from the system.
- ☐ I am managing one of the organisational units where the system is used.
- ☐ I am in the team adapting the system or supporting users.

Figure 14: Example of question in questionnaire

### 5.1.2 Specific user roles

Since the global user teams e-mail list consists of different kind of users as mentioned earlier it was important to us to ask questions regarding the respondents specific user roles. This was important since our aim was to develop course material for end-users and not developers, and we wanted to learn more on what they consider important regarding mentors. Out of the 50 respondents, 40 were either Health Management Information system officer, clerks or health Programme Coordinators, see Table 4. This leaves the remaining 10 respondents to have other roles in the system.

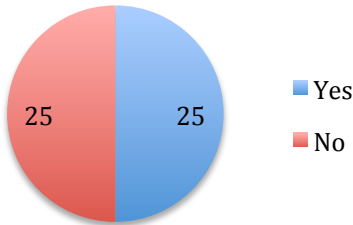
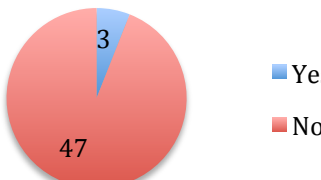
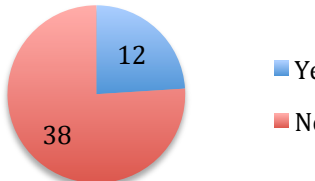
I am a Health Management Information system officer	 <p>A pie chart with two equal halves. The left half is red and labeled '25' with a legend indicating 'No'. The right half is blue and labeled '25' with a legend indicating 'Yes'.</p>
I am a clerk	 <p>A pie chart with a very small blue slice at the top labeled '3' and a large red slice labeled '47'. A legend indicates 'Yes' for blue and 'No' for red.</p>
I am a Health Programme Coordinator	 <p>A pie chart with a blue slice labeled '12' and a red slice labeled '38'. A legend indicates 'Yes' for blue and 'No' for red.</p>

Table 4: Questionnaire findings



### 5.1.3 Expectations to a mentor

The questions asked in this part of the questionnaire concerned what mentors should be able to do. Table 5 lists the rank and mean scores of responses we received.

Rank	Ability	Score
1	encourage other users to use the system	5,42
2	guide other users such that they become able to solve other problems themselves	5,26
3	guide other users such that they become able to solve the particular problem themselves if the problem reappears in the future	5,24
4	communicate with IT people	5,24
5	achieve trust from others	5,21
6	learn new IT solutions, changes, and updates	5,16
7	solve IT related problems	5,10
8	argue convincingly for the purpose of the system towards other users	5,10
9	achieve social ties with others	4,98
10	observe misfits between IT and business	4,71
11	carry out IT related tasks which other users don't want to do	4,64

Significantly lower scores than Rank 1

Table 5: Questionnaire findings - expectations to a mentor

As Table 5 shows there was a high ranking, > 5, on questions related to encouraging and guiding other users. All of the mean scores are above the middle score that should be 3,5 on the 1 – 6 scale. There was less expectations from mentors to argue the for the purpose of the system to other users, achieve social ties and carry out IT related tasks which other users don't want to do. In addition we also got suggestions on other tasks mentors should be able to do that were not listed in the questionnaire. These were:

- Make backup, server management, make screen views
- Conduct training to more people apart from mentorship and coaching
- Communicating to top MOH officials of the status of implementation so as to maintain management support of the projects
- Participate in system development

### 5.1.4 How mentors should learn

The last section of the questionnaire focused on how mentors should learn to become mentors. The results from this can be seen in Table 6.

Rank	Way of learning	Score
1	They should read user documentation.	5,54
2	They should explore all parts of DHIS	5,53
3	They should communicate with other superusers.	5,49
4	They should discuss the quality of their support with those whom they help.	5,39
5	They should receive specific training on the superuser role.	5,33
6	They should read help which is embedded in the software.	5,24
7	They should communicate with IT support.	5,22
8	They should be coached on the job by support people from the IT department.	4,96

Significantly lower score than the other

**Table 6: Questionnaire findings - how mentors should learn**

The table shows that there were high mean scores and just one of the answers is below the mean score 5. This could imply that the respondents do not think that a mentor should be coached on-the-job supported by people from the IT department. In contrast this indicates that a mentor should read user documentation and explore all parts of DHIS, which had the highest ranking. As in the previous section of the questionnaire, we also got suggestions on how the mentors should be trained:

- Assist the users on-the-job settings
- Have own DHIS academies / forums of sharing
- Read ahead of new releases
- Participate in user requirement gathering
- A platform for mentors where all issues collected from all users can be discussed
- Take part in periodic exposure to other implementations of DHIS
- Maintain demonstration applications for there own experimentation

### **5.1.5 Analysis questionnaire**

In this section we will analyse the results from the questionnaire. The results from the questionnaire showed that the respondents had expectations for a mentor to be a motivator, a guide, a communicator and as a person that learns new solutions and solves IT related problems. The two questions in the questionnaire with the lowest ranking was to “observe misfits between IT and business” and “carry out IT related tasks which other users don’t want to do”. These expectations are also highlighted in the literature (McNieve, 2009).

### **5.1.6 Expectations to a mentor**

As we could see from the results, all the answers had a high mean score and they were all above the middle score. This could imply that the respondents mean that a mentor should be able to do everything. The two abilities with the highest ranking were that a mentor should “Encourage other users to use the system” and “guide other users such that they become able to solve other problems themselves”. These expectations correspond with literature in abilities that a mentor should have. McNieve (2009) states that a mentor “Should be willing to embrace the technology, be patient teachers, and be willing to champion the changes brought about by technology. They should be good communicators because they serve as your cheerleaders and frontline problem-solvers” (p. 137). Since the ability to encourage other users had the highest score, it would be likely that a mentor should “argue convincingly for the purpose of the system towards other users” should have had a similar score in the results. This answer however scored significantly below the rank 1 score. A reason for this could be that the respondents find the ability to encourage is more important than the abilities to argue. This could imply that the mentor training should aim at developing competencies and capacity for encouraging others and this is also in line with other studies (McNieve 2009; Poe, Abbot and Pronovost, 2011).

The ability to learn to solve problems on your own came out as rank 2 and 3 in the result. Based on other questions, the result was split into respondents being help givers versus help receivers. The outcome was that those who mainly receive help think that mentors should be able to guide other users, both such that they become able to solve the particular problem and other problems themselves to significantly higher degree than those who mainly provide help. Hence the less skilled want to learn to be able to solve problems themselves, while the more

advanced do not seem to acknowledge that the less skilled want this. This implies that the design of the training material should bridge this gap.

### **5.1.7 How mentors should learn**

As in the previous section, all the answers had a high mean score and all was above the middle score. The three abilities that got the highest rank was “should read user documents, should explore all parts of DHIS and should communicate with other superusers / mentors”. This implies that the training material should enable for communication and collaboration in addition to give simple user documents. This is also in line with research on the CSCL field, and by enabling the possibility to collaborate and provide the media for communication the mentors can function as scaffolds for each other (Stahl et al., 2006).

## 5.2 Design

In this phase of the design process we made three modules to bring with us to the first visit to Malawi. These were a basic module for the Dashboard and Visualizer functions and an advanced module for Visualizer, see Appendix D. We did this to get feedback on what might work or not in order to make a complete prototype. The idea behind these three examples was to make content for e-learning courses and these would be for new beginners and mentors, to give them knowledge to help others. Before we started to make the content for the low fidelity prototypes of the modules, we had to decide what the users needs training on. After informal talks with the Deputy Director for the Center of Monitoring and Evaluation, MoH, we learned that users could benefit from training on the Visualizer and Dashboard functions, instead of Data entry, which they already are familiar with.

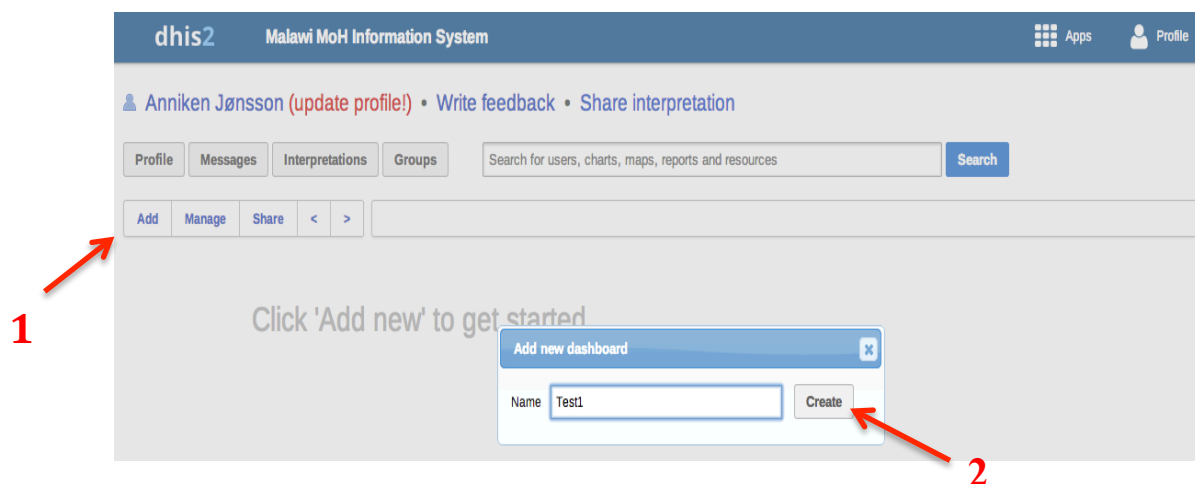
Since the examples we made were intended to be part of an online e-learning course they needed to be short and easy for new users to understand. Therefore we decided to make a manual that shows a specific task step-by-step. It is designed in the way that the task to be carried out is numbered and explained with words. Then it is illustrated in pictures where arrows show which step is carried out. This would in theory help the user to train on the tasks by practicing in the system and following the steps, see Figure 15. These steps follows the essential action in this task, it gives instructions and screenshots at a level that is appropriate for new users, as scaffolding guideline number one suggest (Quintana et al., 2004), see Table 1.

In this phase of the design process, the plan was to use the learning management system called Moodle (Modular Object Oriented Dynamic Learning Environment). This is an e-learning platform and the software is free. The platform focus on interaction, have different environments for learning and gives the opportunity for grading. This would make it possible to evaluate the learning and facilitate for the users to continue to the next level. In addition to the step-by-step modules, we wanted to include small motivational films in the e-learning courses. These films would be of different users in the system, and they would give a short motivational speech to other users in the system.

## DASHBOARD

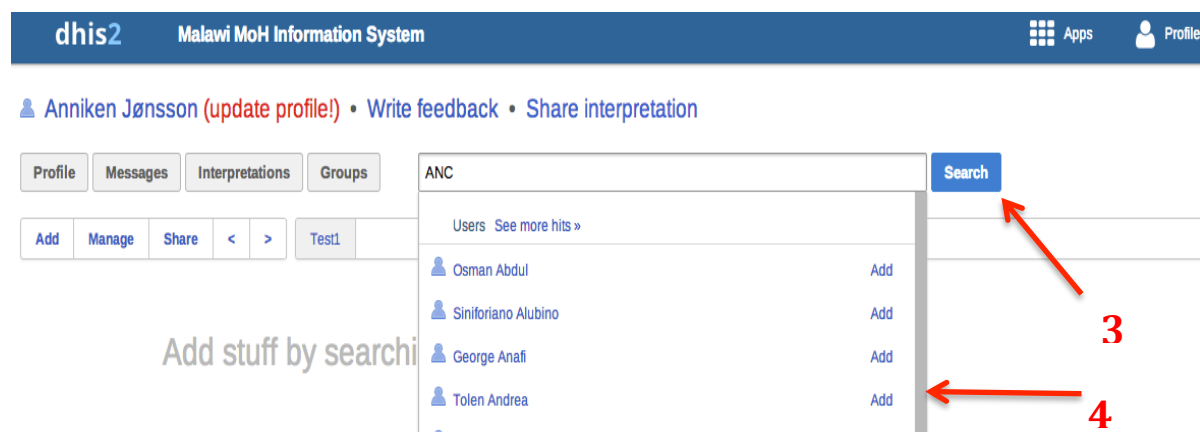
1: Click on add

2: Name your Dashboard and enter create



3: Search relevant users, charts, Pivot Tables, standard reports etc.

4: Click add to add it to Dashboard



You have now created a Dashboard with chosen table

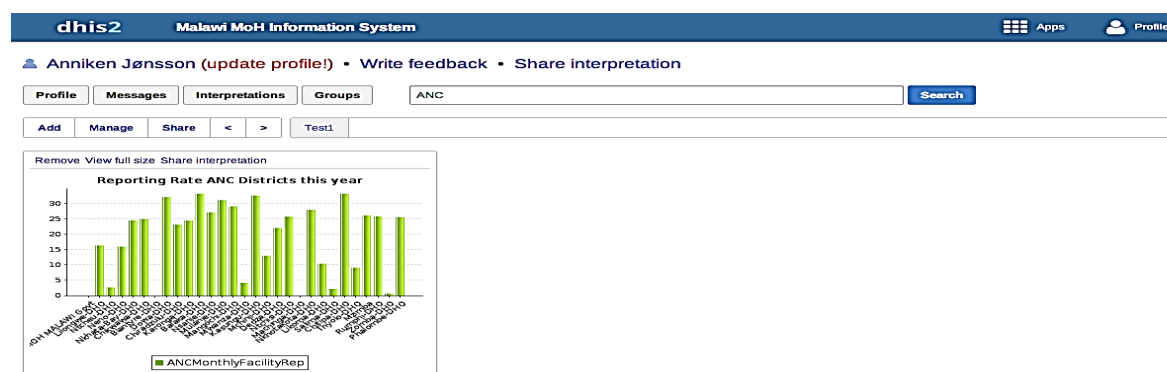


Figure 15: Example Dashboard module

## 5.3 Assessment

In June 2014 we visited seven district hospital administrations where we conducted interviews. The interviews consisted of four themes and these were introduction, DHIS 2 training, relations and feedback from the two module examples. We will now present our findings from these interviews.

### 5.3.1 DHIS 2 training

In this section of the interviews we asked questions regarding former training, what kind of follow-up the interviewee have had after the initial training, the content of the training and if they received any training material during these sessions. We also asked the interviewees if they help others in the system and if they think this is a part of their job.

Between the three groups that were interviewed, HMIS officers, clerks and Program Coordinators, there was a difference in former training. HMIS officers were the group that had received most training, either participating at a DHIS 2 academy or at a weeklong seminar. The clerks had received different training, where one clerk had participated in a weeklong training with two days of theory and three days of practice. Other clerks had received a two-three hours long briefing in the system, and no practice. The Program Coordinators had received the smallest amount of training and it generally consisted of a briefing lasting for two-three hours. Regarding the current training and follow-ups after the initial training the answers were the same. They did not get any specific follow-up training, but felt that they could ask questions either to the HMIS officer or the MoH. One of the HMIS officers we interviewed said that he/she liked to be available to help the clerks and Program Coordinators when they were having problems. Also the Program Coordinators cooperated with clerks when they needed help and training.

*“We do not know if we will get any follow-up. Clerks will support us when we are having problems. There are good cooperation between the coordinators and the clerks” (Program Coordinator)*

Regarding the topic training content, the answers had some differences. The HMIS officers who had attended academies and/or seminars got an overall orientation and practice of the entire system, but at the same time they explained that they did not feel that there were

enough time to go through the functions for analysing data. During training of the clerks, focus had been on data entry and to retrieve simple reports, but little or nothing on how to analyse data in DHIS 2. This also applied for Program Coordinators. Further, when we asked the interviewees if someone had received training material, only one HMIS officer had received a booklet from the MoH that he/she used to train new users. The others had not received any kind of training material during their trainings, and had not used the help functions in DHIS 2, such as the “Help” icon or “Resources”. Concerning the questions on helping others, all interviewees answered that they did help others when needed, and that they could contact the MoH if they were unable to solve the problems themselves.

*“Yes, when they have problems they can come to me or one of the other clerks and ask. If we can’t solve the problem we can call the Ministry of health.” (Clerk)*

In this part of the interviews we also asked what we could do to improve training. From this we learned that they wanted to be able to log into the system and find manuals on training and that these manuals are short and simple.

### **5.3.2 Relations**

On the subject of relations, we asked questions concerning who and where the interviewees can ask for help and what kind of contact and relations they have among each other and upwards with the MoH.

There were some differences between the answers concerning who the interviewees can contact if they have a problem. The HMIS officers answered that they could contact the MoH or the District Team, while clerks and Program Coordinators would mainly contact their HMIS officer. If the HMIS officer could not be of help, they would then contact the MoH, but this applied only a few of the interviewees. We also asked the clerks and Program Coordinators how their relation and contact with the HMIS officer, MoH and other colleagues is, and all answered that the cooperation among them was good. When we asked the HMIS officers, they had the same answers, and they also had contact with colleagues in other districts through Zonal meetings and national meetings.



*“We normally meet quarterly. At national level there was a meeting last year.” (HMIS officer).*

The clerks and Program Coordinators said they could cooperate between themselves and that the relation is good.

*“We have good relations and discuss the data with the Program Coordinators when we get the reports. He/she checks the data, and corrects them if they are wrong and give me clear signal to enter the data. They have their own privileges in the system.” (Program Coordinator)*

### **5.3.3 Visualizer and Dashboard**

At the end of the interviews we showed the modules on the Visualizer and Dashboard functions in DHIS 2. These were the designs made in the initial design process. In addition to these two modules we brought an example of an advance module with common errors in Visualizer. In this phase we could evaluate the design based on Kirkpatrick’s first level of evaluation, which is reactions to the modules. All of the interviewees thought the modules looked nice and could be of help for learning DHIS 2 and training others.

*“One page is good. You get a feeling that this can be done when it’s only one page and not a booklet”. (HMIS officer)*

The overall feedback on the modules was that this kind of training material would be positive since they were short and explanatory. We did not receive any particular feedback on the advanced module we brought, and reasons for this may be due to their general low IT competence or because they can’t use this specific feature of the system. In addition to the themes we have presented, there were two things that emerged through our data material. One was the overall poor Internet connectivity in all the districts we visited. This occurred often and in some of the offices they used Internet Dongles, which is a mobile broadband. The other problem was lack of computers and/or broken computers. Many offices and several of the interviewees used their own personal computers in official duties.

### **5.3.4 Summary first visit**

We have made a short summary of our findings from the first visit in Malawi.

#### **Training**

- The HMIS officers were older and had been in their jobs longer than clerks and Program Coordinators.
- The clerks had statistical background or came straight from secondary school, while the Program Coordinators had health-background.
- The HMIS officers had more training in comparison to the Program Coordinators and clerks.
- The HMIS officers, clerks and Program Coordinators did not have sufficient knowledge regarding analyses of data in DHIS 2.
- The clerks and Program Coordinators had no training material to fresh up knowledge.

#### **Relations**

- There was good cooperation between clerks and Program Coordinators. In one district the clerks had specific programs that they entered data for.

#### **Feedback modules**

- The interviewees were positive to the fact that the modules were short and in one page.
- Wanted to be able to find training material in the system.

## **5.4 Analysis**

In this section we will present the analysis of our findings. First we will analyse the theme training and then relations. Feedback from the examples we brought to Malawi will be included in both sections.

### **5.4.1 Training**

#### **Training needs**

In order to develop a training strategy, we asked questions regarding former training, content of this training and what we could do to help, see interview guide in Appendix C. In this way we learned more about the needs for training, before we started designing the e-learning courses. In connection to this, Goldstein (1986, referenced in Furnham, 2005, p. 461) have presented three categories as explained in section 2.4.2, that a training needs assessment should include:

Organizational analysis:

We found that there is a need for training in most functions within DHIS 2, except for data entry. We also found that clerks are the ones who are doing most of the data entry, and they help Program Coordinators with DHIS 2. We learned that HMIS officers and clerks seemed to be more stabile in their jobs, while Program Coordinators are often transferred to a new job or district. Clerks and Program Coordinators address the HMIS officer when encountering problems, and it would be cost beneficial and sustainable to target both clerks and HMIS officers for training.

Job/Task analysis:

The tasks vary from district to district, and in some districts clerks only do data entry while in other places they also do analysis. Some of the HMIS officers do analysis in Excel, and others do it manually. None of the HMIS officers we interviewed do analysis within DHIS 2, except for generating data set reports. Therefore the e-learning courses need to have a wide range in themes and levels.

Person analysis:

Here we found that there is a need for training in DHIS 2 on an individual level. There is also a need for making a forum for discussions, a community for learners so they can learn from each other experiences.

### **Training design**

An essential part of making a training programme is to establish the foundation for the trainees in order to have an effective transfer of training. As explained in section 2.4 the way for how training is transferred could help new users with motivation and productivity (Grossman and Salas, 2011). From the interviews and feedback on the modules, we learned that design of the e-learning courses should be short and easy to understand with little text. It should also include work tasks on different levels.

### **Work environment**

After we learned that the districts we visited have problems with poor Internet connection, we decided to move away from the initial plan, which was to make the e-learning courses within the Moodle community. We also decided to move away from the motivational videos in the course material since these can be difficult for the user to upload and watch. If it is difficult to watch the material, the learners may not use it at all. Also, the training skills are more likely to transfer if they take place in the actual work environment and have on-the-job training (Grossman and Salas, 2011).

## **5.4.2 Relations**

The reason for asking questions regarding relations was to find out more about support and follow-up, since this is essential for creating champions.

### **Support**

An important factor for having a good work environment is to have support from supervisors and peers. From our findings we learned that support from leaders and colleagues were different. Most of the interviewees told that their relations with others were good, and we learned that clerks were good supporters to Program Coordinators that used or wanted to start using DHIS 2. This also applied for HMIS officers, and this told us that we should have a

focus on these two groups when making the e-learning courses. They seemed to be the best candidates for being good champions for the system.

### **Champions of DHIS 2**

A core element in this thesis is to find and cultivate champions of the system. Relations to leaders and colleagues are essential ingredient to find these champions, to motivate and cultivate them to become mentors in the system. From our findings we saw that the relation varied from the districts. In one of the successful districts there was a very engaged HMIS officer that supported the staff with questions, training, and follow-up. In another district that were not so good in their reporting rate, there was a more controlling HMIS officer that liked to do most of the tasks on him/her own.

In section 2.2.3 in the theory chapter one can read that champions are individuals who crave for new knowledge and scouts for opportunities in internal and external material. In our interviews we met several committed and engaged users that were craving for more knowledge in order to use the system better. A strategy for making these mentors champions should therefore be to support them, and as a leader or peer sell DHIS 2 as an opportunity for the motivated users, in order to learn more skills and let them see the organizational benefit so they can engage others afterwards (Howell, 2005).



## 6 Evaluation cycle

In this chapter we will describe the evaluation cycle, starting with the design process of the basic user courses and mentor courses. Then we will present our findings from the training sessions and finally we will analyse and discuss our findings.

### 6.1 Design

Based on the findings from the exploration cycle and relevant literature, we started to design the e-learning courses. After learning that Internet connections were poor, and that it was desirable to find training material within the system, we decided to use an in-app solution within DHIS 2. By doing this we would address the Internet problems, since DHIS 2 operates through minimised data transfer in areas with poor connectivity. In addition the users don't have to learn to use an e-learning tool, because it is already in the system and we would fulfil the condition of realistic training environment in Grossman and Salas (2011).

The app would consist of three apps, and these would be a course-taking app, a course-writing app and a course evaluation app. The course-taking app would be available in the App menu within DHIS 2, where users can take the course at any time.

During this process we also had a meeting with members from the HISP team in South Africa, where we discussed the training material they already have made and how this should overlap with our training material. They sent us their material, which we used as a part of our foundation when making our course content. After this meeting we finished a requirement specification for the app, which will be developed in another master thesis.

#### 6.1.1 Requirement specification for e-learning app

The idea behind the app is to target end-users in District Health Offices and possibly facilities, to enhance knowledge on basic user level and educate new mentors. The rationale in the requirements was that *“Programme Coordinators stay in their positions for short duration while clerks and HMIS officers seem to be more stable, such that breeding some of them into mentors who can guide others, can help the learning issue”*. The initial structure in the first stage of designing the e-learning courses can be seen in Table 7.

<b>Levels:</b>	<b>1 User level</b>	<b>2 Mentor level</b>	<b>Customizer level</b>
<b>Aim:</b>	<b>Use DHIS</b>	<b>Guide others and help solving their problems using DHIS</b>	<b>Set up the local system</b>
	<b>Topics</b>	<b>Sessions</b>	
1a	HMIS	Passed	Passed
1b	Data Entry	Passed	Passed
1c	Data Validation	Passed	Started
1d	Dataset report	Passed	
<b>1. Data entry Course completion</b>		<b>Passed</b>	<b>Started</b>
2a	Indicator. Interpretation of data	Passed	
2b	Visualizer	Started	
2c	Dashboard		
2d	...		
<b>2. Reporting Course completed</b>		<b>Started</b>	<b>No</b>

**Table 7: Requirement specification**

As one can see from the table the idea was to make the e-learning courses on two levels, the user level (which is now called basic level) and mentor level. In each of these levels the trainee would conduct a session and take the modules. The status for each level and module would be *No*, *Started* and *Passed*. After passing a session, the trainee could proceed to the session for the same topic in the next level, or to the next module on the same level. The course completion criteria would be

- a) Passed all sessions.
- b) Contributed to the Community.

The reward would be to receive a certificate from Ministry of Health & University of Oslo or a local institution.



User roles would be defined as:

- Learner: User carrying out the session for learning the topic at this level.
- Examiner: User approving the session for learning the topic at this level.
- Guided: User being guided by the learner.

The app will be added to the App-menu online in DHIS 2 and appear in a separate browser window with no overlap with the application as seen in Figure 16. The app will occupy  $\frac{1}{4}$  of the screen on a computer, leaving the rest of the screen for practicing in the DHIS software. By displaying the e-learning courses in this way it eases learning and the users can see the instructions and the software to be learnt at the same time. The illustration in Figure 16 is created by Lima and Manzoor for their forthcoming master thesis on creating the app.



### **6.1.2 Content e-learning courses**

We decided to make two courses on basic user level for new beginners, with five modules in each course. This is based on the findings from the exploration cycle, where we learned that clerks and Programme Coordinators had mainly gone through training on data entry and little/ or nothing on analysing data and their level of skills was on different levels. Therefore we needed to start the courses on a beginner level before designing courses on a mentor level, because we need to build knowledge step-by-step. The theory behind this was Vygotsky's proximal zone of development, where one scaffolds the trainee by helping them through the courses and to reach a higher level of competence. The reason for only making two courses on basic user level and two courses on mentor level was because of the time limitations we had in this thesis, before we were going back to Malawi to test and evaluate the courses.

Further, in the meetings for the requirement specification and at the start of the design process, we discussed what a user should learn in order to qualify as a mentor. Based on these conversations we decided the themes for the courses and that the mentor courses should follow the basic user courses with the same topics. By doing so the mentors would have a higher knowledge on the same areas as their mentees. In addition to this we decided to add an extra module in the mentor course, regarding data quality, since there is a problem that data with poor quality is entered in the system. It is therefore important that the mentor learns more about this topic, in order to teach this to new users. Based on HISP South Africa's material we selected topics to use in our courses, see Table 8 for table of contents.

<b>1. Introduction to DHIS 2</b> <ul style="list-style-type: none"> <li>1.1 What is DHIS 2</li> <li>1.2 How do I start using DHIS 2?</li> <li>1.3 How is DHIS 2 structured?</li> <li>1.4 How does data capturing fit into the information cycle</li> </ul>
<b>2. Data Quality</b> <ul style="list-style-type: none"> <li>2.1 What is data quality?</li> <li>2.2 What mechanisms are used to improve data quality?</li> </ul>
<b>3. Aggregated data capturing</b> <ul style="list-style-type: none"> <li>3.1 What is aggregated data`</li> <li>3.2 How do I open the data entry form/tool?</li> <li>3.3 How do I capture data from the paper form?</li> <li>3.4 How is data saved?</li> <li>3.5 How do I check for data capturing errors and violations?</li> <li>3.6 How do I submit data for sign-off reporting?</li> <li>3.7 How do I save or print a data entry form/tool?</li> <li>3.8 How do I edit/change data?</li> </ul>
<b>4. Reporting</b> <ul style="list-style-type: none"> <li>4.1 What are the building blocks of a report?</li> <li>4.2 How do I report data per entry form/tool?</li> <li>4.3 How do I create a report for data quality analysis?</li> <li>4.4 Dashboard: What is it and how do I use it?</li> </ul>
<b>5. Patient/Event Data Capturing and Reporting</b> <ul style="list-style-type: none"> <li>5.1 Patient data</li> <li>5.2 Hybrid: Anonymous Patient Data</li> <li>5.3 DHIS 2 Patient Record Types</li> <li>5.4 Capturing Single Events Without Registration</li> <li>5.5 Capturing Multiple Events with Registration</li> </ul>
<b>6 Troubleshooting</b>

**Table 8: Table of contents from HISP South Africas material**

As one can see from the figure, HISP South Africa had themes such as introduction to DHIS 2, data quality, subjects in data entry and reports. These are examples of subjects that overlap with our first course on the basic user level, as one can see from Table 9. This is done

deliberately as cooperation with HISP South Africa, so the content are similar for users taking the course in South Africa or through the e-learning courses. It also helps to create similar standards for user patterns, and to not confuse users taking courses both in South Africa and online. In addition to this, the sequence of the module, see Table 9, is placed so that information is presented at a level that is suitable for the learner, according to Quintana et al., (2004) scaffolding guideline number two, see Table 1. Therefore we start with data entry, which we learned from our assessment that most users are familiar with. As the users knowledge increase, the themes of the modules gets more difficult. Table 9 is a list over the topics in basic user course and the mentor level courses.

<b>Course 1: User level</b>	<b>Course 1: Mentor level</b>
1. Introduction to HMIS and DHIS 2	1. Introduction to HMIS and DHIS 2
2. Data Entry	2. Data Entry
3. Min / Max data validation check	3.1. Data quality
	3.2. Min / Max data validation check
4. Data Validation: Data type validation and common errors	4. Data Validation: Data type validation and common errors
5. Data Set Report	5. Data Set report
<b>Course 2: User level</b>	<b>Course 2 Mentor level</b>
1. Indicators	1. Indicators
2. Pivot Table	2. Pivot Table
3. Visualizer	3. Visualizer
4. Dashboard	4. Dashboard
5. Messaging	5. Messaging

**Table 9: Table of contents our courses**

As seen in the table we have added a module in the first mentor course, and it contains six modules instead of five. In order to not confuse the users, we called the extra module 3.1 as a part of the Min/Max data validation check since it is additional information on the same subject.

### **6.1.3 Second design of Basic user modules**

From the meetings discussing the requirement for the app, the exploration cycle and relevant literature, we decided that the layout for the basic user modules should include four different

components. The initial structure of the courses was made in the requirement specification, but after further discussions and literature research we ended up with a third design that was tested in the evaluation cycle. The initial structure that was drawn in the requirement specification can be seen in Figure 17.

## Course taking app

### 3.1 User level session

1. Presentation (2 pages, possibly a few seconds of video)
  - a. Motivation for the usefulness
  - b. Presentation of concept – Structure & function
  - c. Instructions – sequence of steps for doing the task
2. Test. One or more of
  - System log showing that the Learner has accomplished the task on the system
  - Quiz
  - Approval from the Examiner

Figure 17: Illustration of layout in requirement specification

As one can see from the figure this format is the foundation for how the e-learning modules look today, with small changes. What we want to accomplish with these e-learning courses is to create champions in DHIS 2. In order to do that we needed to make a training program that encourages and provides the necessary knowledge in order to cultivate users to be effective champions that motivates and help others. The initial idea was therefore to have a component in the modules that would motivate the users. After this it would be a component that shortly explains the structure and the functions in the relevant modules, so the users could get a better understanding. Since we wanted to activate the users to practice it was necessary with a component with step-by-step instructions. At the end of the modules we wanted to test the users in their new knowledge. Since the content is for an e-learning app we chose to have a multiple-choice assignment. By doing so we could use this as an evaluation method, and the users would get an immediate feedback on the answers and if the module is passed.

### 6.1.4 Third design of Basic user modules

The third design of the e-learning modules has the same foundation as in the second design process, with some alterations. One change we made in the basic user courses is that we renamed instruction to practical exercises, and this is done so that the users will understand

that they should practice the steps within the system. This version also differs from the modules we brought to Malawi in the exploration cycle, where we only had the practical exercise. The third design has four components, and these are motivation, structure and functions, practical exercise and assignments and the modules are now two pages, instead of one. Next we will give an explanation of each component, their content and the reason for including them.

### **Motivation:**

This component include few sentences on why the user should learn to use the functions in this module and what they will gain from this, see Figure 18. In the job facet theory, explained in section 2.4.1, one critical psychological state in working life is experienced meaningfulness (Furnham, 2005, p. 313). This component therefore intends to create an understanding for the task significance that can increase motivation, and then again increase the experienced meaningfulness of learning this.

### **Structure and functions:**

Includes a short presentation of the structure and functions of the area within DHIS 2 that this module covers. This is to give the user an understanding of structures hidden behind the surface. Some users generate adequate understanding on their own, but this does not apply for everyone, and this component is therefore included to prepare users for more challenging tasks. Also, studies have shown that the use of direct instructions and conceptual models is beneficial for novice users (Mayer, 1989). The explanation in this component should be according to Mayer (1989) complete, concise, coherent, conceptual, correct and considerate explained in section 2.2.1. This is also emphasized in learning IT use for mentors, see section 2.2.4, where creating an understanding for why the functions works as they do will help strengthening the mentees problem solving competence that they need as future mentors (Kaasbøll, 2015)

### **Practical exercise:**

This component contains a practical presentation of the area the module covers within DHIS 2. This is presented as a step-by-step practical exercise where the user can follow each step and do them at the same time. Each step is explained first by word and a number, and then illustrated in a picture with the numbers and an arrows showing the action explained. The reason behind this component was to get the user to be active in practicing the task instead of

just reading what to do. Also, as explained in section 2.4.2, effective training strategies are explanations of the behaviour that should be learned and opportunities to practice the tasks (Grossman and Salas, 2011). This is of particular importance for transfer of training to occur and we intend to facilitate that with this component.

Further, it also helps explaining the task in a simple way for the user, and in that way scaffolds the user by building knowledge step-by-step within their proximal zone of development. In other words this component is designed to give a helping hand for the learners to learn and accomplish the task.

**Assignment:**

Includes a quiz with three questions and three options to each of them. The intention behind adding these assignments was to get the user to reflect upon their new knowledge and to test learning. The three questions addresses one of the components in the modules see Figure 18. In this example question one address motivation, question two is addressing structure and functions, and the last question address the practical exercise. The job facet theory enhances feedback as a factor for motivation (Furnham, 2005), and this component provides immediate feedback to the learner on the actual result and if the user passes the module or not.

Research has showed that three options is the optimal number of choices (Rodriguez, 2005). The reason for this seems to be that with more than three options, the person being tested can complete fewer questions during a given time. And three options are sufficient to avoid high scores for random choices (Rodriguez, 2005). An example of a module in the basic course is shown in Figure 18.



## 2. Data Entry

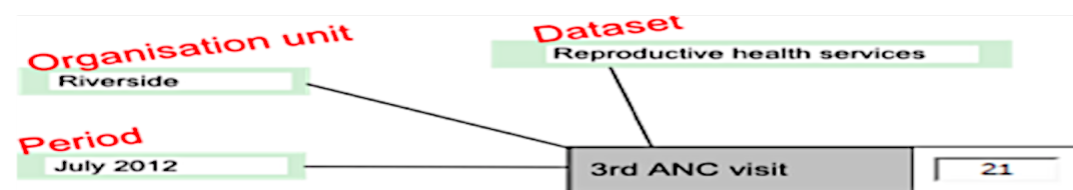
### Motivation

Data entry is the starting point for the entire system; if no data is entered, there is no data in the system to be analysed. When you enter data in DHIS2, the system can be used to make analysis more effective, improve data quality, make reports and enable comparison of data across time and place.

### Structure and functions

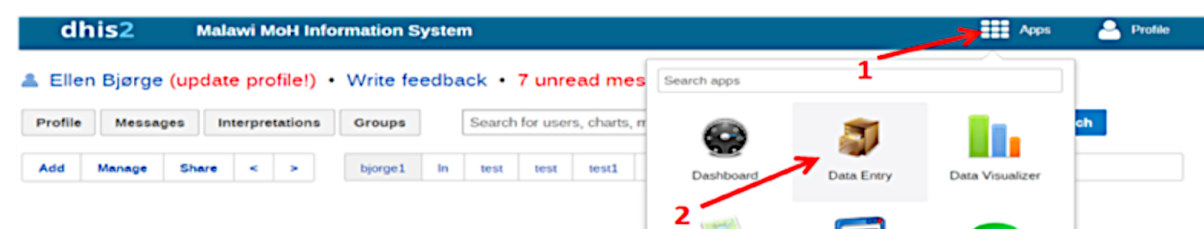
Data are entered into the system as data sets, which correspond to reporting forms filled out in health facilities. For example is the HMIS 15- data set, which includes core health data. If data is entered while there is an interruption to Internet connectivity, the data is stored locally in the computer. When Internet connectivity is available, the data will be uploaded to the online server automatically. So don't switch off the computer until you are online again.

**Data set:** The data set is associated with a period (when) and an Organisation unit (where).



### Practical exercise- Data Entry

- 1: Click on the **Apps** button up at the right on the screen.
- 2: Click the **Data Entry** button as the arrow shows.



- 3: Click + once to move down.



- 4: Single click on the name of your organization unit to select it.
- 5: Your selected organisation unit is displayed on the main window of the data entry screen.
- 6: Choose the data set to fill in your data from the **Data Set** dropdown list.
- 7: Select wanted year.
- 8: Choose the period you want to enter data for from the “period” dropdown list.

- 9: Fill out the form.
- 10: When you are finished, click on the **Complete** button.

## Assignment

### Why should you enter data into the system?

- a) To make analysis of data more effective.
- b) There is no need to enter data in the system.
- c) To make health decisions more ineffective.

### A number which you have entered in DHIS2 belongs to

- a) A manager, a data entry clerk and an organisation unit.
- b) A Country, an organisation unit and a period.
- c) An organisation unit, a period and a data set.

### How do one choose correct organisation unit?

- a) Double click on the + sign.
- b) Single click on the + sign and single click on your selected unit.
- c) Write the name of the organisation unit in the organisation unit field.

Figure 18: Example Data Entry module in Basic User Course

### **6.1.5 Theory modules**

Within the e-learning courses we find two modules that deviates from the others since they are theory based and there are no practical exercises with step-by-step instructions, see Figure 19. The first theory module is an introduction to HMIS and DHIS 2, and the second module is on indicators. The reason for having both modules is emphasized in theory to create understanding for the mentees before doing the more practical modules. Understanding and skills are correlative, and in order to have understanding the mentee needs to know why functions work like they do. Kaasbøll (2014) explains the need for IT understanding by saying that “understanding will in general ease transfer of skills to new situations, like the introduction of new software versions, systems, gadgets and IT services” (p. 12). This understanding has also shown leads to better abilities for problem solving (Kaasbøll, 2014). So, it is therefore important to have these modules in order to make users more equipped for new situations when learning IT skills, and more competent for solving problems when being a mentor, see Appendix E for examples of the two theory modules. A short explanation of what these modules contains is given next.

#### **Introduction to HMIS and DHIS 2**

In this module we give an introduction to HMIS and give a short introduction to DHIS 2. We included this modules because we expected that there was a need for having a theoretical foundation where we introduced what HMIS and DHIS 2 are before the users moved forward in taking the more practical modules. The module is based with text, and has the same length as the other modules.

#### **Indicators**

As seen in Table 9, basic user course 2 starts with a module called indicators. We wanted to include a theory chapter regarding indicators, before the modules regarding Pivot Table and Visualizer where data analysis is done. In this module we give a simple explanation on what an indicator is, how to calculate them and show what an indicator within DHIS 2 is through an example. We included this module so new beginners would have a theoretical review on indicators and know what indicators in DHIS 2 are, before they start to do practical exercises in the next modules.

# Course 2: User level

## 1. Indicators

### Motivation

In order to see where efforts are needed, we need to compare performance against targets. If the target is 85% immunisation coverage, it is not enough to know that we have vaccinated 900 children; we also need to know how many children we should have vaccinated. To get the percentage, we divide the number of immunised (900) with the number of children under 1 year (1000) and multiply with 100, and we get the coverage rate 90%. In DHIS2 the indicators like immunisation coverage are calculated for you; you only have to choose the relevant indicator and know how to create a report, chart or Pivot Table to show the result. However, it's important to know the basics about indicators and how to calculate them, such that you understand the output from DHIS2.

### Structure and functions

First a definition: “*Indicators are variables that help to measure changes, directly or indirectly*” (WHO, 1981). So, the indicators “*show a given situation, and thus can be used to measure change*” (Green, 1992). For example a baby's weight for age is an indicator of the baby's nutritional status. Indicators are often calculated through two numbers called:

**Numerator:** is a count of the events that are being measured; for example new cases of TB, number of doctors etc.

**Denominator:** is the group with which the things we count are compared; for example total population, total of health centres, total of births in a year etc.

Further, there are three main types of indicators in the DHIS2:

**Proportion indicator:** the numerator is contained in the denominator; its resultant values are often expressed as a percentage. For example the proportion of health centres in a country without ivermectin is:

$$\frac{\text{number of health centres without ivermectin (Numerator)}}{\text{total number of health centres (Denominator)}} * 100 \quad \text{Or,} \quad \frac{150}{2000} * 100 = 7,5\%$$

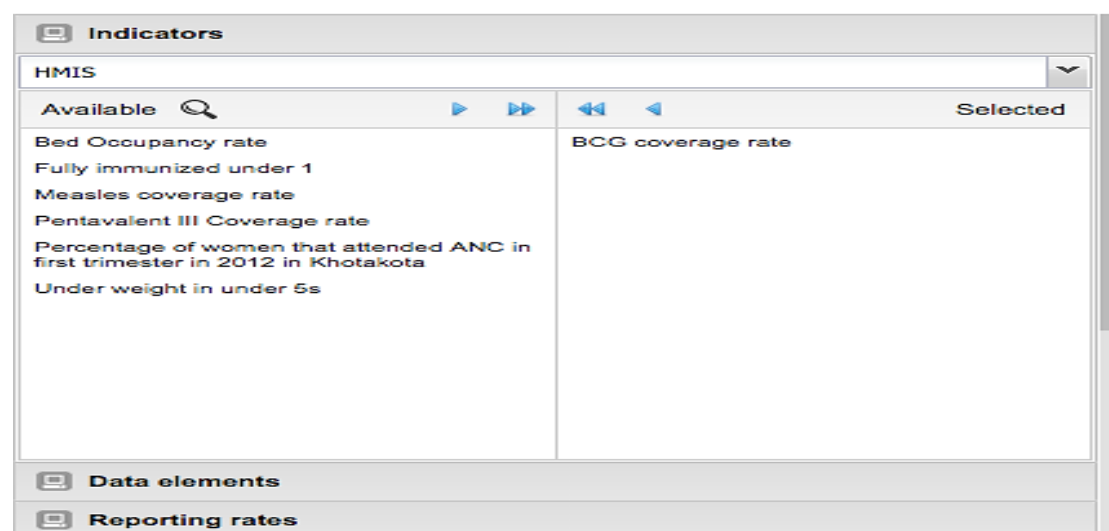
**Rate indicator:** the frequency of the event in a specific time in a given population; usually expressed per 1000 or 100 000 population. For example incidence of malaria cases in children <5 year in a country per year, and per 1000 children < 5 are:

$$\frac{\text{number of cases of malaria in children under 5}}{\text{population of children under 5 per year}} * 1000 \quad \text{or,} \quad \frac{10000}{600000} * 1000 = 16,7$$

**Ratio indicator:** Numerator is not included in the denominator. For example the ratios of male AIDS deaths in comparison to female are:

$$\frac{\text{number of male AIDS deaths}}{\text{number of female AIDS deaths}} \quad \text{Or,} \quad \frac{450}{350} = 1,3 \text{ male deaths per female.}$$

These indicators will DHIS2 calculate for you when you generate a Pivot Table or a chart. An example of indicators that you can choose from in DHIS2, can be illustrated like this:



From the figure you see HMIS indicators where you have chosen BCG coverage rate when you are going to generate a Pivot Table or a chart.

### Assignment

#### 1. Why do we need indicators?

- a) To be able to compare health service performance.
- b) To add data from many facilities into a total.
- c) To export data into an Excel-sheet.

#### 2. What is the correct calculation of the indicator ANC visits in first trimester?

- a)  $\frac{\text{number of mothers coming for their first ANC visit in their first trimester}}{\text{total population}} * 100$
- b)  $\frac{\text{number of pregnant women}}{\text{number of mothers coming for their first ANC visit in their first trimester}} * 100$
- c)  $\frac{\text{number of mothers coming for their first ANC visit in their first trimester}}{\text{number of pregnant women}} * 100$

#### 3. What is a numerator?

- a) The group, which the things we count are compared.
- b) Count of events that are being measured.
- c) Count of events that are being compared.

Figure 19: Example of Indicators module in Basic User Course

### 6.1.6 Initial design of Mentor modules

After making the two courses on basic user level we decided to start with two courses on mentor level. First we discussed the themes of the courses, and then the layout for the mentor courses. The topics discussed were what kind of format the modules should have, and which components these modules should include. The layout agreed upon in the requirement specification was used as a foundation in designing the mentor courses, which is shown in Figure 20.

#### 3.2 Mentor level session

1. Check that the Learning user has passed the previous level on this topic
2. Presentation (2 pages with links to User Manual and other documentation, possibly video)
  - a. Issues which people have when learning this topic
  - b. Instructions for helping/guiding/teaching it
3. Test. One or more of
  - System log showing that the Guided user has accomplished the task
  - Quiz
  - Approval from the Examiner (can be the Guided user)

Figure 20: Illustration of layout in requirement specification

As seen in the figure the foundation for the mentor courses consisted of presentation, which included the later called *Guidelines* and *Common errors*. It also contained a test/assignment in form of a quiz or an assignment approved by the mentor or a system log. The idea was to create modules that could scaffold the learner to become mentors and give instructions on how to do a mentor session. Each module would end with a test that the learner had to pass in order to go to the next step in the course.

### 6.1.7 Final design of Mentor modules

After more discussion and research in literature, we decided on five components for the final layout we tested in the evaluation cycle. These components were similar for all modules and they are:

**Prerequisites:**

Includes what a mentor should prepare before starting a session in the specific module. We included this component in order to prepare the mentor, see Figure 23 and Figure 24 for examples of prerequisites in the mentor modules. This component is also emphasised in education theory, and it describes planning and preparing as essential for all teachers to do properly. Meaning, when teachers or mentors plan their session, this will have an influence on what the mentees learn. Another issue that makes planning before the lessons important is to use the time effectively (Woolfolk, 2004, p. 354).

**Added value for the mentee and the health management:**

This component contains sentences on which benefits mentoring others give, and the organisational benefits to enhance motivation. As explained in section 2.2.3, Howell (2005) describes a strategy for how effective champions can influence others, and this is framing the innovation as an opportunity and not a threat. In order for the mentors to engage others they must see the value they can get out from it, and the value that organization might get in a longer term. This component was included to give extra motivation to the mentor for engaging their mentees.

**Guidelines:**

Includes guidelines for how the mentor can supervise mentees during the corresponding tasks in the basic user course. We included this component to give knowledge to the mentee in order to improve quality of the training sessions and a way for the mentor to scaffold the mentee by facilitating on-going articulation and reflection (Quintana et al., 2004), see Table 1. The intention behind the guidelines is also to make the basic user courses more interactive than they would have been on their own. An example of this can be seen in Figure 21, where the guidelines give tasks for the mentees to do. The different guidelines in the modules, involves a variety of tasks, including explaining, questioning, assessing and give feedback. These are techniques that can provide effective mentoring (Roscoe and Chi, 2007, p. 540).

**Guidelines**

1. Make the mentee explain while choosing data element, period, organisation unit, so you know he/she understands it correct.
2. Make the mentee find favourite indicators (if they have any) in DHIS2.
3. Make the mentee make different types of charts, with different dimensions; for example a linear diagram where one compares between two facilities over time.

**Figure 21: Example of Guidelines from Visualizer module**

**Common errors:**

This component includes a list of common errors that users tend to do in this module. It prepares the mentor, and in this way they can use subtle hints to imply that the mentees answers are incomplete (Roscoe and Chi, 2007, p. 553). This can again lead to scaffolding interactions between the mentor and mentee. In addition, Grossman and Salas (2011) highlight the trait called error management, see section 2.4.2. Error management allows the mentor to anticipate what can go wrong, and it will again equip them with the knowledge to handle potential problems. Recognizing a misconception is easier if the mentor has been informed of those that occur regularly. An example of the common errors component can be seen in Figure 22.

**Common errors**

Some common errors can be

- When comparing facilities the chart only has one column.
- That no indicators are available.
- That you can't change the title of the chart.

**Figure 22: Example of Common errors from Visualizer module**

**Assignment:**

In the exploration cycle, we learned from the questionnaire that mentors should have a platform to discuss issues collected from users, see section 5.1.4. Based on this and literature, we decided to focus on communities of mentor practice and the assignment in this component involves sending a message to a mentor group we had created for this occasion. Using the message function in DHIS 2 and focusing on the community may contribute that the mentor evaluate their training sessions, which again can lead to improvements and building



knowledge. Feedback from others may help repair the gaps and misconceptions that the mentor originally had, and this could enhance their understanding and strengthen the community (Roscoe and Chi, 2007). Using the group to ask questions can also be a reinforcement to create knowledge. An example of modules from the mentor courses can be seen in Figure 23 and Figure 24.

Since the knowledge ideally should be higher at a mentor level, the information given in the mentor course is designed to meet scaffolding guideline number one and two in Table 1. This means that the learning material is presented in a manner that is appropriate for the learner. As seen in Figure 23 and Figure 24, the mentor courses do not include any illustrations or step-by-step instructions. A novice user might have problems conducting the mentor sessions, while a mentor that has higher knowledge should not have problems with this. All of the components are designed to bring out potential tacit knowledge the mentor has, which is hard to communicate. The components that address to extract this knowledge are the guidelines, common errors and assignments.

## 2. Data entry

### Prerequisites

Before you start mentoring a user on data entry, bring a pen or some other pointer to be able to point to the + sign and other small spots on the screen. Make sure that you have the data set form with collected data that the mentee should enter into the system.

### Added value for the mentor and the health management

One of the benefits by mentoring others in data entry, are that with new users there will be more data available in the system for doing analysis, which is essential. You will also get colleagues that can help you with the workload of entering data.

### Guidelines

1. Make the mentee open Course 1, Module 2 Data entry, and start working.  
Compare data input form with the mentee's Excel sheet if any.
2. Observe closely what the mentee is clicking on and typing.
3. If a data validation check is triggered, explain that we will come back to that in the next module.
4. If something goes wrong, explain why unexpected things happened. Guide the mentee back on track by saying which menu choices to make and buttons to push. Make the mentee use the keyboard and mouse, don't take over.
5. A tip for the mentee is to use Tab button to go to the next field. Shift+Tab will bring the mentee back a step.

### Common errors

Users can often do errors if there is an interruption to Internet connectivity.

Data entry Online: If data entry is made while there is connection to the Internet, all data entered are saved automatically and instantly.

Data entry Offline: If data is entered while there is an interruption to Internet connectivity, the data is stored locally in the computer browser. When Internet connectivity is available, all data will automatically be saved. Make sure to keep your computer running.

### Assignment

Send or answer a message to the mentor group on some reflections of what you have learned about data entry.

Figure 23: Example of Data entry module in Mentor Course

# Course 2: Mentor level

## 1. Indicators

### Prerequisites

Before you start mentoring a user on indicators, you need to calculate some examples manually to show the user. It is also wise to have some paper to write on if you're going to calculate some examples together manually.

### Added value for the mentee and the health management

As a mentor you will advance your own knowledge about indicators in how to calculate them manually and how to fetch them in DHIS2. This is essential knowledge to use the system. As a mentor you also do an important job in enhancing other users knowledge as well.

### Guidelines

1. Make sure the mentee understands the definition on indicators, and the difference on input and output in DHIS2.
2. Make the mentee explain the difference between nominator and denominator.
3. Make the mentee write down the three most important indicators for her/his area.
4. Calculate some examples manually and find them in the system afterwards.

### Common errors

Confusion between input and output, especially with the data set report, that is in the same format as the data entry form.

### Assignment

Send or answer a message to the mentor group on some reflections of what you have learned about Indicators.

Figure 24: Example of Indicator module in Mentor Course

## 6.2 Assessment Basic user courses

In this section we will present our findings from the evaluation cycle where we visited four different District Health Offices in November / December. As explained in the methodology chapter we visited each district twice during two weeks and went through the basic user courses the first week and mentor courses the second week, see Table 3.

### 6.2.1 Basic user course 1

The first module in this course is introduction of HMIS and DHIS 2. Two of the mentees, a HMIS officer and a clerk gave feedback that there was nothing to add. The other two were eager to continue and started with the Data entry module, which is the second module in the course. They knew this module well and answered the questions in the assignments easily. Three of the mentees gave us feedback that the module lacked a validation step otherwise the feedback was good.

The third module, min/max data validation, the two HMIS officers had used the first version of DHIS and therefore they were familiar with min/max rules in advance. The two younger clerks were not familiar with this function and it was new to them. The min /max validation function in DHIS 2 gives the user a notification in form of the colour orange when numbers entered in the system deviates from the average value. This average is calculated in the system from data entered the last six months. Since this function were set up by us before visiting, all of the mentees had noticed the change in the system and were eager to discuss these. Therefore this module needed extra explanation from our side and an example of this was that we had to ensure one of the clerks that he/she could click the button complete, even though the numbers have the colour orange. All of the mentees gave us feedback that this was a useful and good module.

*“I liked this, it is good because sometimes people can do mistakes when entering data”*  
(HMIS officer)

In the data validation module, only one HMIS officer and a clerk tried it out, and they gave feedback that they thought it was an ok module, but data entry is slower with the new validation rules.

*“For me it is OK, but when this error pops up it is slower” (HMIS officer).*

The HMIS officer explained to us that a common mistake he/she does is to push comma when entering data, and this was a tip we could include in our mentor course. The other two mentees had this point lost some of their interest and went straight to the assignment. The last module in basic user course 1, data set report, one HMIS officer and a clerk knew this function well and thought it was good. The other clerk told us that he/she did not use this function often, because it was the HMIS officer who did most of the analysis. We also got feedback from one of the HMIS officers that he/she had misunderstood question two in the assignments. In this HMIS officers district, a data entry form is called data set and this was confusing for him/her, see Figure 25. He/she selected answer option a, while the correct answer is b.

**2. What is a data set report?**

- a. The same as the data entry form.
- b. Facility data and aggregated data at district and higher levels.
- c. Facility data and patient data at district and higher levels.

Figure 25: Example of assignment from Data Set Report module

### 6.2.2 Basic user course 2

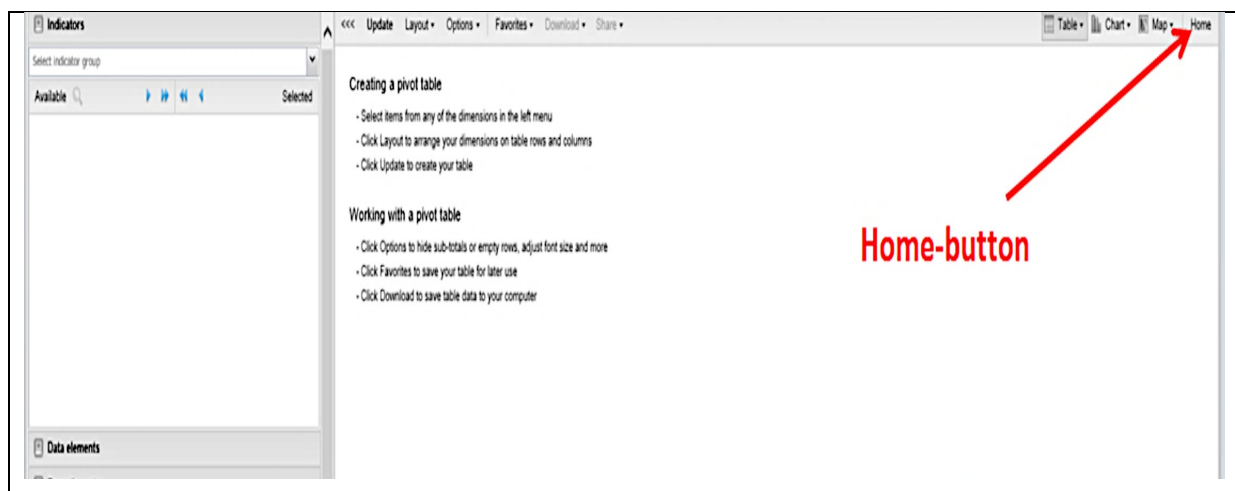
The first module in basic user course 2 is the theory module on indicators. The mentees had good knowledge regarding indicators, but it was the HMIS officers who were most experienced. One of the HMIS officers gave us feedback that the indicator module were good and that it was useful and necessary to include this so everyone learns it.

*“Clerks must know about indicators and know how to calculate them” (HMIS officer).*

The other HMIS officer thought it was a lot of text, but still an important module to go through. One of the clerks asked if indicators are calculated in DHIS 2 and we explained that this is correct and that he/she could do analysis within the system. The other clerk went straight to the assignment and was eager to answer the questions. In the Pivot Table module we learned that none of the mentees knew this function well. One of the HMIS officers tried

to make a Pivot Table while we functioned as mentors and when he/she selected an indicator and clicked on the update button, the system would not make a table because there is a lack of population data. The other HMIS officer and the clerks only read through the module. One of the clerks lacked Internet the day we visited and were therefore not able to try out the modules in the system. Even though they did not do the practical exercise, all of the mentees answered the assignments.

During the Visualizer module all of the mentees tried to make a chart, except for the clerk who lacked Internet that day. None of them had used this function before and they all had problems with navigating in the system. An example of this is when you are in the Visualizer app and want to go back to your dashboard you can do this by using a button called “Home”. Figure 26 is a screenshot from the system, showing where the home button is localised. Our course material did not include any explanations to this button, see Visualizer module in Appendix E. Instead the mentees used the back button in the browser, and they had to log into the system once again.



**Figure 26: Screenshot from DHIS 2 - Home button**

As Figure 26 shows, the “Home-button” is small and placed in the corner, and due to this the mentees struggled to find it and know its function. In the Visualizer module we also had to inform how one can save charts through favorites and inform the mentees that it is wise to name the chart with names they will remember later on. This was in connection with the next module, dashboard, where we asked the mentees to search for the chart they had created and add it to their dashboard. The mentees had never used the dashboard function in DHIS 2 before, so this was new territory for all of them. Like one clerk answered on a question if he/she use this function,

*“No. I have seen it, but I have not done more about it” (Clerk).*

Further he/she said after reading the module,

*“I have wondered about what this is, but I didn’t know what to do with it or how to do it” (Clerk).*

We as researchers explained during this module that the dashboards are private, where to find the dashboards they have created, and how to navigate between different dashboards. For more information regarding dashboards, see section 3.3.1. One of the mentees struggled with the first step of creating a dashboard, and for some it was confusing to know which name that was suitable for the dashboards. The last module we tested was messaging and none of the mentees had used this function before, but they all knew about it. One of the main problems they all mentioned were the automatic messages they received every time they had clicked the complete button in data entry. As one of the clerks explained to us,

*“I wonder why they come and what function it has” (Clerk).*

Some of the mentees had almost two hundred unread messages and if the amount of unread messages becomes so high it starts to get difficult to manage for the users. One of the clerks also said it was easier to use a normal e-mail instead of the message function and that he/she preferred this. The other clerk read through the module thoroughly before he/she answered the assignments, and asked questions if one could send messages to a specific user. We explained all functions, and at the end of the module the clerk said that,

*“This is an eye-opener” (Clerk).*

The two HMIS officers also read through the module and tried to send messages in the end, one to a colleague and one to the mentor group we had created before our arrival to the training sessions.

In this phase of the training sessions we could evaluate the first level, reactions, in Kirkpatrick’s four levels. The reactions we got from the training modules were overall

positive and we received feedback on elements that were missing in the course, such as an extra validation step in data entry. We also got feedback that some of the questions were easy. Even though the mentees did not give us any verbal negative feedback, we could see that some of the courses did not work as we intended them to. An example of this is the dashboard module, where one of the mentees said while reading through it that this would be easy. When he/she started to go through the practical exercise, it was more difficult than anticipated. This gives us an indication that the module does not work optimally, even though the mentee does not verbally express it.

### **6.2.3 Summary Basic user courses**

- The clerks were less trained than the HMIS-officers, which had worked with the first version of DHIS and now DHIS 2.
- All of the mentees knew the first course well, but started to struggle after the indicator module in the second course. They rarely use DHIS 2 to do analysis.
- Two of the mentees read through the introduction module, while the other two mentees skipped this module.
- All knew the data entry module well and answered the questions easily.
- All needed extra explaining from us in the min/max module.
- One of the mentees tried the data validation module and said it was ok.
- For the data set report one HMIS officer said it was good and one of the clerks did not use this function often.
- HMIS officers knew indicators within DHIS 2 better than the clerks, but all of them were in general good in indicators.
- The “Home” button was difficult to find.
- None of the mentees had good knowledge regarding the functions Pivot Table, Visualizer and Dashboard.



## 6.3 Assessment Mentor courses

We will now present our findings from the second week, where the mentees from the first week acted as mentors for a colleague in the two basic user courses. We did not go through the mentor courses while we conducted the first training sessions, because it would be too time consuming in addition to the basic user courses. Therefore the mentees got an assignment to the next sessions, which was to read through the mentor courses and do the necessary preparations. We will now present the findings from the mentor courses.

### 6.3.1 Mentor Course 1

Before starting the sessions, the mentors helped the mentees to log into DHIS 2, and two of the mentees had problems with this. After logging in, all of the mentors went straight to the data entry module and skipped the introduction, which is the first module in basic user course one. Going through the data entry module, the mentors explained thoroughly what the mentee should do and which buttons to click. They all had prepared some forms in advance so the mentees could enter data in the system, and during data entry all of the mentees encountered the min/max validation rules. The mentors therefore explained the min/max module during data entry. As one can see from Figure 27, the steps in the module asks the mentees to fill out the form and then click on the complete button. All of the mentors asked their mentees to click the button run validation, even though it is not described in the module. One of the mentors guided their mentee to click the complete button, then run validation, and if the data validation function gives a list with numbers to check they should click the incomplete button, see Figure 27. This is a more comprehensive way to use these functions.

9: Fill out the form.

10: When you are finished, click on the **Complete** button.

89	Dysentery – inpatient deaths	
98	No. of road traffic accidents-inpatient deaths	

10

9

Complete Incomplete Run validation

Figure 27: Example from the Data Entry module, Basic User course

As mentioned the mentors explained the min/max data validation module when the mentees entered a number that turned orange. The mentors explained like we did to them the week before, that these numbers need to be followed up. This is also emphasised in module 3.1 – Data quality in the mentor course, see Appendix E. All of the mentors made the mentees double click on the numbers so the data information window would appear, which is one of the guidelines in the mentor course. Figure 28 shows an example of a data information window, and here the users can see the min/max limits and the average. The chart gives the user a visual overview over the last entered data and in addition to this the user can mark the star, and make a comment in order to follow-up the numbers.

The mentors explained the functions in the data information window and asked the mentees to make a comment and mark the star. One of the mentors was uncertain on this module, since it was new knowledge. This module was also difficult for two of the mentees and they needed thoroughly explaining from the mentors. At the end, the mentees answered the questions in the quiz. When one of the mentees answered wrong, the mentor asked him/her to explain why this was the correct answer, and asked him/her to read through it once more. One of the mentors asked us at this point if the mentee should do the assignments and the answer was yes on this. The mentor went back to the assignments from the other modules, and made the mentee answer the assignments and from there on he/she answered all the assignments.

One of the mentees entered a number that did not pass the validation test, and the mentor asked the mentee to explain why. After discussing the number and checking the data information window to see the last six months of data entry, the mentor decided that this was wrong based on the local knowledge they have, and they changed the number.

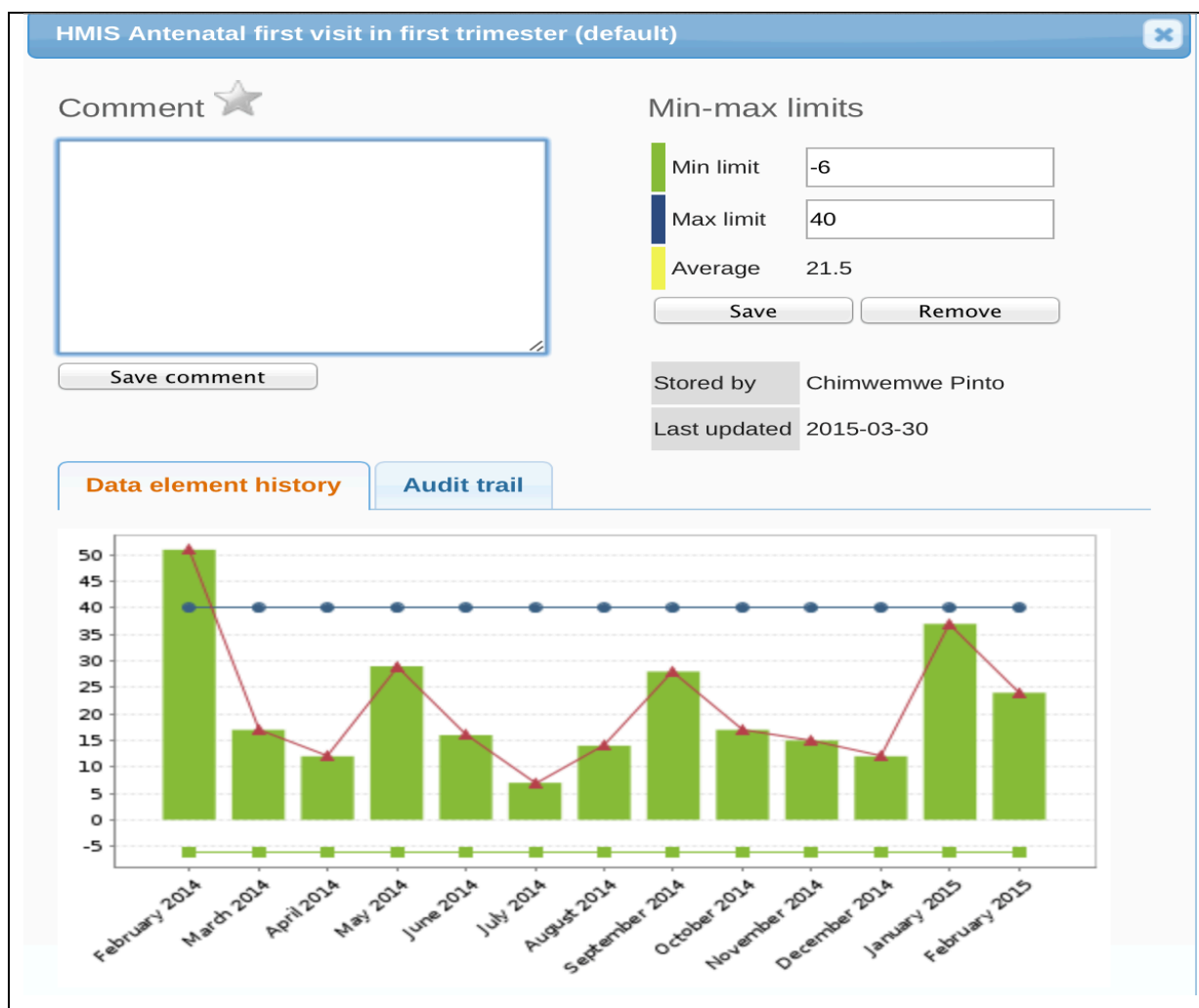


Figure 28: Example of a Data information window

In the last module, data set report, the mentors asked the mentees to fetch a specific report. One of the mentors rushed through the module, while the others took it slow and explained thoroughly the different functions. None of them took over mouse or keyboard, but let the mentee try the different functions in the system. At this point two of the mentees struggled due to their low computer skills. One of the mentors also asked the mentee to find the report that he/she had entered during the data entry module too see what happened. This was one of the guidelines from the mentor course, see Figure 29. When entering data into DHIS 2 it takes twenty-four hours before one can fetch a data set report, and this is because analytic data tables are generated through the night. The mentor then asked the mentee questions on why the report did not appear, and explained why it did not show.

**Guidelines**

1. Encourage the mentee to use this report for checking data input.
2. Make the mentee go to Data set reports and find data from the day before or older. Make him/her create a Data set report.
3. Make the mentee export the report to an excel sheet. Guide the mentee on where the file should be saved.
4. Make the mentee find data that has been entered the same day. Ask about why the data is not shown.

**Common errors**

Fetching a data set report straight after entering data; it takes 24 hours before one can fetch the data set report after entering data.

**Figure 29: Example from Mentor course - Data set reports**

### **6.3.2 Mentor course 2**

In the indicator module, two of the mentors let their mentee read through it and answer the assignments in the basic user course, while the other skipped this and started the Pivot Table module. Afterwards, they went back and answered the assignment in the indicator module. In the Pivot Table module one of the mentees followed the steps all the way through without the mentor interfering. The other two mentees needed the mentor to explain the steps and tell them what to do. During this the mentees did not read the step-by-step themselves. At one point one of the mentors also did the practical exercise for the mentee in order to help the mentee to go forward. In the Visualizer module two of the mentors explained thoroughly how to do the steps. One of the mentees skipped the text, and did not follow the steps. Instead he/she used the mentor to ask questions and get explanations. All of the mentees had problems when they were going to make the chart. Another problem we could see here as well as during the first week of training sessions were that the mentees struggled to navigate in the system. The main problem was to switch between Visualizer and Pivot Tables, as well as going back to their dashboard and app-menu, using the home button.

During these sessions the mentors were uncertain when the mentees asked questions, since their knowledge was new and they had little experience. In these situations the mentors asked us for questions when the mentees struggled and we gave them the answers. Further, when going through the dashboard module the mentors were uncertain in their knowledge, since

this was new territory for them as well. One of the mentees had a surprising reaction to this module after reading it when he/she said,

*“This is easy” (Clerk).*

When the mentee started to do the steps it turned out to be more difficult. The problems that the mentees struggled with were the same as in the sessions during the first week. In the last module messaging, the mentees had lost their focus. One of the mentees was occupied with his/hers mobile phone and the mentors were uncertain in their knowledge since they hardly had used this function themselves. One mentor went into messages and we helped him/her to make a group for all the clerks in the district office. Thereafter the mentor sent a test-message to the new group while the mentee observed.

After these mentoring sessions, the mentor received a diploma, which was accredited by us as researchers. The diplomas were very appreciated by the mentors and the response was good.

In this phase we could evaluate the basic user courses on Kirkpatrick’s second level of evaluation, which is learning. This is an assessment of what the mentee has learned throughout the course. Since the mentees from the first week now acted as mentors for others, we could assess their learning curve from the first week. This kind of assessment is usually done by pre- and posttest and our pre test will be the training from the first week. What we could see from this assessment was that the mentors were uncertain in the modules they had less experience from such as Pivot Tables, Visualizer, dashboard and messages. Since the training was conducted during two weeks we cannot for certain assume that the basic user courses do not work as desired. Regardless, this indicates that more time between basic user course and mentor course is needed, and the mentors need to have more experience from problem solving in the system. We could also assess the mentor courses on the first level of evaluation, which is reaction to the training. We were not present when the mentors read through the course for the first time, but after the training session we conducted a short interview where we asked questions regarding the courses. The feedback we got from these short interviews were that the courses was ok, and but it was hard to practice them at home since they did not have any computer there. This gives us an indication that the preparations to the courses should be done during work hours, where they have access to Internet and computers. Other feedback we got were some minor additions, such as adding a point to the

common error component in data entry. Here we learned that a common error that is often done is punching mistakes, such as entering a comma instead of a number.

### **6.3.3 Summary Mentor Courses**

- Two of the mentees had poor computer skills and struggled with using the mouse, to log into the system and navigate within DHIS 2. Sometimes they used the back button in the browser and managed to go out of the system and had to log in again.
- The mentees that had poor general computer skills was dependant on having a mentor present next to them, while the mentee that had better computer skills could have managed to do the basic user courses on his / her own.
- One of the mentees did not use the manual at all, just listened to the mentor explaining and reading the assignments for him/her.
- Two of the mentors had clearly read through the mentor courses. Therefore, we deduce that they mentioned common errors like reports couldn't be fetched the same day that the data is entered.
- One of the mentors used the guidelines in the mentor course actively. He/she also commented some common errors during the session.
- All of the mentors skipped the first module and started on the data entry module.
- All of them had prepared forms for the data entry module.
- They all explained the min/max module during the data entry module, like we had done the week before.
- The mentors were sometimes uncertain on the correct answers in the assignments. The result of this was that the mentors did not correct their mentees when answering wrong.
- The mentor course does not give instruction to make the mentees read through the modules during the session.

## 6.4 Analysis and discussion - Basic user courses

In this section we will present our analyses and discussion of the basic user courses and we have divided it into four themes. These are participants, basic user course modules, basic user courses and work conditions.

### 6.4.1 Participants

During the first week we mentored two HMIS officers and two clerks, and they were familiar with the system. So from Grossman and Salas (2011) theory one can say they have a higher ability and therefore a higher self-efficacy to perform on a given task within DHIS 2. This is in contrast to new beginners in the basic user courses. All of the mentees seemed highly motivated and had a perceived utility of the training, especially the clerks, because they mentioned several times that this could be of much help for them and others. All except for one HMIS officer spent good time doing this session when we visited them, and was eager to try out each module. From our perspective these mentees are therefore champions that are good candidates for being mentors.

### 6.4.2 Basic user course modules

In the first week the mentees were experienced in the system, while in the second week two out of three mentees were novice users. An effective training strategy according to Grossman and Salas (2011) includes clearly defined explanations of behaviour, opportunities for trainees to practice learned skills and the provision of feedback and social reinforcement.

Table 10 shows a list over the percentage for correct answers on the assignments in basic user courses. Since none of the mentees answered the questions in the first module, Introduction to HMIS and DHIS 2, these are not included in these calculations. So this is based on nine modules, instead of the original ten modules.

Component	Correct answers
Motivation	71 %
Structure and Functions	66 %
Practical Exercises	73%

Table 10: Results from quiz

**Motivation:** None of the mentees gave feedback on this component. A reason for this could be that the mentees were experienced in the system, they already knew this information, or that it covers what they need to know. None of the mentors gave instructions to read this component during the second week. Motivation is according to the checklist presented in Figure 3, often a necessary accompaniment for learning. This is also emphasized in the job facet theory, where three of five job dimensions point to the experienced meaningfulness in the job for high motivational score. As explained in section 6.1.4 each question in the quizzes address a component in the module. The questions addressing motivation has 71 % correct answers, see Table 10. So, even though the mentees did not give feedback on this component, their answers tells us it worked partly as intended, and the mentees did not have any problems explaining why they should learn and do the relevant module. During the second week, the mentees managed to answer the questions correctly as well. From our findings, this component seems to give the wanted effect on motivating the mentees and increasing their understanding for why to learn this exact module. However, one could try to change the questions to be more reflecting and challenging, since all the mentees managed to answer without reading the component thoroughly. Another way to reinforce could be to give the mentors direct instructions in the guidelines to explain the motivation behind the relevant module or to make the mentee read through the component on his/her own and afterwards discuss it with the mentor.

**Structure and functions:** Here the findings were the same as with the component on motivation. The idea from the design process was that we wanted to give extra theory regarding the modules, so the basic understanding was enlarged (Kaasbøll, 2014), as explained in section 2.2.4. However we saw that when they struggled with a quiz-question in the assignments, they went back to this component to read once again, in order to answer. We could also see this from the quizzes with 66 % correct answers, see Table 10.

Since this component is meant to prepare users for more challenging tasks, it can be more demanding than the motivation component. Therefore it may take more time in order to gain understanding and have the ability to express why a function in the system works in a specific way (Kaasbøll, 2014), see section 2.2.4. Due to this, the assignments acted as a reinforcement to make the mentees read this component properly and make them reflect upon it.



**Practical exercise:** This component managed to activate the mentees, so that they practiced the steps to be learned. We could see that the first module, data entry, were familiar, and they gave us feedback on steps that were missing. This indicates that they have an understanding, since they can correct mistakes in the material. In the min/max module on the other hand, the mentees faced new territory and they were at this point dependant on the e-learning courses and needed it to do the practical exercises. This component started therefore to scaffold the mentees, especially in the sense-making process, see Table 1, where one use representations through pictures and language to bridge the mentees understanding. In that way this component explains and build the mentees knowledge step-by-step, while practicing at the same time. The mentees are therefore more likely to process the new information through accommodation and create new knowledge (Woolfolk, 2004), as explained in the constructivist learning theory in section 2.1. We could find traces of the accommodation process when the mentees had enlightening experiences, and an example is when one of the mentees expressed after completing the module regarding messages,

*“This is an eye-opener” (Clerk).*

We could see during the two weeks of training that the mentees that were fluent in computers managed to follow the practical exercises on their own, while the novice mentees with poor computer skills were dependant on having a mentor present to guide them through the steps. This component therefore worked as a scaffold for the experienced user, while the mentor had the role as scaffolder for the novice users. Therefore blended learning, which means a combination of two kinds of learning environments, is necessary in order to reach both user groups. This also facilitates interactivity, which again can enhance learning (Cook et al., 2010). In the assignments, this component had the highest percentage of correct answers, see Table 10, indicating that the mentees has reflected over their new gained knowledge.

**Assignment:** For the experienced mentees, some of the quizzes in assignments were easy. However we could see that they had to go back to the user course module in order to answer some of the questions. This forced the mentees to reflect upon what they had just learned.

For the novice mentees conducting the training during the second week, we could see that the assignments were more challenging and they needed to go back to the courses and read to

find answers. Therefore this component worked in engaging the mentees to reflect upon what they had just learned before going further to the next module. However, some of the questions were easy for the novice users, and we changed them in the revised edition, see section 7.4. This component also correspond to the checklist of good training, presented in Figure 3, where one of the points is to have a question/discussion session to clear up misconceptions, and a summary and review so one can establish whether the mentee meets the criteria or standard. This component also gives the mentees feedback on their training after taking a module, and feedback is proven to support learning (Grossman and Salas, 2011).

### **6.4.3 Basic user courses**

For the different modules in the courses we could see that it was increasingly difficult for the mentees and mentors. However the learning curve seemed suitable for all the mentees. For the two novice mentees, the success was dependent on the mentor's skills to guide them through the courses and the scaffolding effect was through the mentor. The e-learning courses would not be enough in itself. In section 2.3, we presented results from Hatties (2009) meta-analyses. In these results, web-based learning scored low, indicating that it has little effect. Therefore the content of the modules is essential for learning effect. Further, the meta-analyses showed that web-based learning were equivalent to no learning at all. Since the design of our courses includes having a mentor present, this facilitate for scaffolding interactions between the mentee and mentor (Roscoe and Chi, 2007). This is in line with Cook et al. (2010) studies, see section 2.3, where interaction is a functionality that enhances learning. This is facilitated in our courses through the blended learning approach.

### **6.4.4 Work Conditions**

When it came to the work conditions for doing the basic user courses we saw that Internet was a problem for the mentees. In one session during the first visit the Internet did not work, and we had to go through the courses manually. We also observed that there was a problem with the accessibility of computers. In almost all of the districts we visited, the clerks had to share computers, and in some districts they shared with Program Coordinators as well. The HMIS officers had in two of the districts a laptop, which made it easier for them than the clerks. However, the clerks mentioned that they could borrow the laptop if necessary and if they were available. This influenced the sessions and the opportunity to perform. This can

therefore decrease the conditions for good transfer of training (Grossman and Salas, 2011), as explained in section 2.4.3.

## **6.5 Analysis and discussion - Mentor courses**

In this section we will present our analysis and discuss our findings of the mentor courses from the second round of training sessions. We have divided this section into four themes and these are participants, mentor modules, mentor courses and work conditions.

### **6.5.1 Participants**

During these training sessions two out of three mentees were new beginners in the system, and did not have much previous knowledge regarding DHIS 2. Therefore one can assume from the theory on transfer of training, that these two mentees would have a lower self-efficacy than the mentee with more knowledge in the system. Among the mentors it was the HMIS officer who had most experience within the system, and were therefore more likely to have the highest rate of self-efficacy than the other two mentors, who were clerks and less experienced.

### **6.5.2 Mentor modules**

In this section we analyse and discuss each component in the mentor course.

#### **Prerequisites:**

In this component we learned that all of the mentors had prepared a form to be entered in the data entry module. For the rest of the modules we could see that some of the mentors' had done preparations as explaining data quality while the mentee conducted the min/max module and finding a report from the same day in data set reports. It therefore worked to some extent, were one scaffold the mentor in how to prepare a session in the relevant module. This component is in that way helpful and important for the mentor, and will according to Woolfolk (2004, p. 354) influence what the mentees learn, and make the sessions more time-efficient.

#### **Added value:**

None of the mentors read through this component when we were present, and none mentioned it in the sessions. Therefore it is unclear if they had read it in the modules and got

some added value on why one should mentor someone in these modules. Due to this the intended effect on added motivation is difficult to analyse.

### **Guidelines:**

During the training sessions we could see signs that all mentors used this component in some extent during the training session, while one of the mentors used it actively during the whole session. This was one of the clerks from the first visit, and he/she used it as instructions on how to go about the session. Therefore this component showed to be useful and successful in scaffolding this mentor through the session, and eased the process management as explained in section 2.2, such as give expert guidance to the mentees for different tasks (Quintana et al., 2004). The instructional guidelines worked as intended when the mentor quickly could look them up when necessary, since it is easy to forget long series of operations (Kaasbøll, 2014, p. 25). Some of these guidelines encouraged discussions, and from these we could see collaborative construction of knowledge between the mentee and mentor that involved processes of negotiation and sharing of meanings (Stahl et al., 2006). An example of such a discussion was the min/max rules where the mentee and mentor discussed what happened if they ignored the orange number. The guideline that brought this discussion is found in module 3.2 in the mentor course, see Appendix E, and it is guideline 2 which says “Ask the mentee why some values change a lot, while others little”.

### **Common errors:**

Two of the mentors explained common errors, for instance that fetching a data set report the same day as entering the data will not be possible. Therefore it worked in some extent as intended in helping the mentors remembering common errors that they should explain to their mentees. In this way the mentors made the mentee reflect upon common errors and expand their understanding and remove some possible obstacles for using DHIS 2, and this contributed for strengthening their problem solving competence (Kaasbøll, 2015). This component also prepared the mentor in error management, so they can anticipate what can go wrong and it equips them to cope with potential problems. This also happens in realistic training environment where the training skills are more likely to be transferred to the job.

### **Assignment:**

The assignments that we had prepared for the mentor course did not work as we had intended, which were to create a community of mentor practice. With a community like this

one can as a member share information, experiences and help each other (Kaasbøll, 2015). There were no room for the mentor to send messages during the sessions, since they did not use a computer. Since we as researchers also were a member of this group we could see that the mentors has not used this group later on after the training sessions. This component did not work, and needs to be amended in the future.

### **6.5.3 Mentor courses**

The two mentor courses followed the sequence in the basic user courses. Since the mentors read trough it at home it is difficult to analyse if the sequence was suitable to learn and the content covered enough. What we found in the sessions were that all the mentors struggled to teach the mentees when they came to the second basic user course. Therefor the second mentor course was not enough to make them comfortable in their knowledge in these modules. In these modules Vygotsky's proximal zone was too small for them within one week and only reading through the mentor courses. It is a need for creating more knowledge before they reach the mentor level we expected, and to make the assignments in the mentor course more interactive.

After the mentor had completed the courses and conducted mentor sessions with a colleague, they received a diploma accredited by us as researchers. These diplomas were more appreciated than anticipated, and can work as an incentive for mentors to complete the courses.

### **6.5.4 Work conditions**

When the participants went through the mentor sessions there was support from us as researchers and they had been made aware of our work through the MoH. We saw that this had an impact on the mentors, taking the time and being motivated to go through the sessions properly. Like Grossman and Salas (2011) says about support "Both supervisor and peer support significantly influence the propensity for trainees to utilize trained competencies in the workplace" (p. 113). However there were strong limitations through poor Internet connections and lack of access to computers. An example is that in one of the mentor sessions had to be cancelled due to the lack of Internet in the district. This affect the opportunity to perform for the mentees, as explained in the theory transfer of training. Like Burke and Hutchins (2007, referenced in Grossman and Salas, 2011) say "employees need

ample opportunities to apply their new skills to the workplace for positive transfer to occur” (p. 114). The lack of such opportunities can according to Grossman and Salas (2011) “seriously inhibit the use of trained competencies on-the-job” (p. 114).

## 7 Conclusion

Our main intention for making the e-learning courses was to provide training for end-users and cultivate them to being mentors for others. In this way we broaden the focus for training through academies and central support, to create local user competence for mentoring colleagues. The e-learning courses will also be cost effective since there is no need to travel and has a potential to reach approximately 50 000 end-users. In this chapter we will present our conclusion based on our research questions, findings and our analysis. We will first repeat our research questions and go through the conclusions on each question, before we make recommendations and present possible areas for further research.

1. What is sufficient training and support to make people who are neither managers nor computer scientists able to champion and support a health management information system at their workplace?
2. How can e-learning courses be designed to improve user competence in areas with poor connectivity?
3. How should the contents of training courses be structured in order to cultivate champions of DHIS 2?

### 7.1 Sufficient training and support

Based on our findings on the training needs, analysis from our visits and relevant literature, we will in this section summarize and conclude what we found to be sufficient training and support in order to champion and support a health management information system at their workplace. Does our training program contribute to solve these needs as intended?

#### 7.1.1 Sufficient training programme

From our training needs assessment and informal talks with Mr. Chris Moyo, the Deputy Director for the Center of Monitoring and Evaluation, MoH during the exploration cycle we learned about our target group and what could make a sufficient training programme.

Since clerks have DHIS 2 as their main task, where they mainly do data entry, generates reports and that they already help others such Program Coordinators, we learned that they are

the ones with most need of training. We also found that the HMIS officers that have had training earlier, also have a need for more training on data analysis. Based on this we concluded that we needed to target a broad group with our training programme, with a special focus on clerks.

We also found that former training had been conducted in different ways among the interviewees. Due to this we saw a need for making a training program that is easy accessible for all users, to ensure a standardised training. So, the conclusion to this was to make a training program through an in-app solution within DHIS 2, where all users can take the e-learning courses at any time and become mentors in the end. However, this effect on easy access and if it creates a more standardised training needs more research when the in-app solution is implemented.

Since we had learned that former training of clerks was limited and they have been our main focus, we decided to make the training programme start at scratch and build the mentees knowledge step-by-step until they reach a sufficient level to become a mentor. Based on this we designed the e-learning courses on two levels, a basic user level and a mentor level. After testing these two levels in the evaluation cycle, we learned that there was a gap between the basic user level and the mentor level that were not covered. We could see this gap through the uncertainty in the mentors' knowledge during the mentoring sessions. That is, the proximal zone, as explained in section 2.1, was too small to reach the mentor level during our test (Wertsh, 1991). Our the training program is therefore not sufficient enough and based on this we will in section 7.5.4 recommend a third level, called advance level, between the basic user level and the mentor level.

### **7.1.2 Support**

Support is highlighted in the theory transfer of training, section 2.4.3, to be an important element in the mentees transfer of training (Grossman and Salas, 2011). This is support from both supervisors and peers. The training programmes intention is to give the mentees support through mentors. After testing the training programme in the evaluation cycle, support from mentors seems to be a key success to scaffold and motivate mentees through training. The support from local supervisors on district and national level, such as the District Health Officers, HMIS officers and MoH has from our observations been positive and some HMIS



officers have also participated in our research on training. However, in the exploration cycle we did not ask questions regarding relations and support to all types of supervisors, such as the District Health Officer, and this area on support from supervisors needs more research.

An area for improvement regarding support is to make a community of practice, as explained in section 2.2.5, to share and discuss tasks, problems and experiences in DHIS 2 (Wenger, 1998). We tried to do this with the mentor group in the mentor courses, but due to how our training sessions were designed there were no room for the mentor to do this task during the session. A solution could therefore be to reinforce the mentor group and to make a community for the mentees as well. For reinforcing the mentor group one should have a person in charge on the national level, to follow-up the group. In the mentee group there could be a mentor in charge in each district for follow-up.

## **7.2 How can e-learning courses be designed**

In this section we will go through research question number two and give our conclusions on how the e-learning courses should be designed for meeting the training needs and the limitations through poor Internet connectivity.

We found that the work environment is important for the design and the transfer of training. During our first visit to Malawi, in the exploration cycle, we quickly discovered that the districts have poor Internet connectivity and that many of the users have little access to computers. Our initial plan of having the e-learning courses in a separate program, Moodle, would be a bad solution. It can be difficult to upload the software and this could lead to the fact that the training material would not be used. Another reason is that we learned through the exploration cycle that computer skills vary in a large extent, from not being able to log into the system to fluent users. Placing the e-learning courses within DHIS 2 would address the problem with poor Internet connectivity since it operates through minimised data transfer and offline mode when the network is down. It would also make it easy accessible the user when he/she has the time and access to a computer. In addition to addressing the Internet connectivity problems, having an in-app solution will ease learning for the users, and they don't need to learn new software in order to learn DHIS 2. Since skill varies from user to user, all obstacles should be removed and a realistic training environment should be pursued, as pointed out in the literature (Grossman and Salas, 2011). We conclude that the solution is

to place the e-learning courses within DHIS 2 and have a resemblance between the subjects taught and work tasks. The app on the other hand needs further research when it is implemented in order to see if this solution works.

According to the training process checklist with ten points, see Figure 3, a training design should for example be motivational, suitable in length and complexity, and tasks should be demonstrated. Our suggestion to the design of the modules follows these examples, and another reason for why it is important that the length of the courses is short, is due to the fact that we recommend it to be an in-app solution. As one can see from Figure 16, the app will occupy  $\frac{1}{4}$  of the screen on a computer, leaving the rest of the screen for working on the DHIS software. With this solution it is necessary that the modules are short and has little text.

In the evaluation cycle we learned that was dependant on having the illustrations from Malawi's version of DHIS 2 in the practical exercises. This became clear for us when the Internet was down in one of the districts, and we had to use the demo-version, which uses Sierra Leone as a foundation. Therefore our conclusion for the course writing app that is described in section 6.1, should be placed on national level, since this will facilitate the different nations to customize the training programme. This can again enhance the generalizability of the training programme. The functions of the course-writing app need to be tested when it is implemented. Another recommendation we present in section 7.1.2 is to make communities of practice on basic user level and mentor level. We suggest that the person in charge of following up these communities with feedback and tasks should have access to the course evaluation-app. On basic user level it could be a committed mentor and on mentor level it could be a person from national level. However, these recommendations should be explored when the app is implemented.

## **7.3 Content basic user training**

In this section we will address research question number three, and since we have made both basic user courses and mentor courses we have divided this research question into two topics, content of the basic user training and content of the mentor training.

### **7.3.1 Components in Basic user courses**

When it came to the content of the modules we found that the component on motivation, based on the answers from the quiz, worked. The mentees had an understanding on why they should learn and do the different modules and tasks. From the job facet theory, understanding meaningfulness of the job leads to enhanced motivation. Our conclusion is therefore that this component works and should be kept in the courses. A reinforcement to create a deeper understanding and the meaningfulness of tasks, like explained in section 2.4.1, could be to instruct the mentors in the mentor course to explain motivation and discuss it afterwards (Furnham, 2005). Other possible reinforcements can be to make communities of mentor practice where one discuss and share information around the subject, have systematic follow-up after someone have become mentors, and to give rewards for taking the course. In this way the mentee can be motivated from different channels. Due to poor Internet connectivity and potential problems with uploading videos, we chose not to use short motivational videos in the e-learning courses. However, it should be considered to have such videos in the mentor courses, since this group is more likely to be smaller due to a higher level of competence than the basic user courses and they will know how to download the videos and not be demotivated by waiting.

Based on the answers from the questions addressing the structure and function component, we could see that it worked as intended. The mentees struggled some in their understanding compared to motivation, but still managed to answer the questions with a 66 % correct score, see Table 10. When they struggled, they went back in the module to find the answer.

Therefore we will conclude that this component should remain in the basic user course. Regardless, more research on this when the e-learning app is implemented, to compare results. A suggestion for reinforcing this component could be to make the questions more reflecting in order to enhance understanding. This will enhance the problem solving competence when the mentee does the practical exercises (Kaasbøll, 2014), as explained in section 2.2.4.

For the component practical exercise, we found that it worked as intended and activated the mentees to practice the task. We could see that giving the mentees clear instructions to learn skills as explained in section 2.2.4 on how to do tasks, made it easier (Kaasbøll, 2014). It also made it easier for the mentor to follow the sessions and explain how to do the steps. Our conclusion is that this component is one of the core elements for success in this training programme, for scaffolding the mentees knowledge step-by-step in their path to reach mentor level and to eventually become mentors.

The assignment in the end of each module worked to evaluate the mentees knowledge, to see if they had reached the wanted level at this point in the course. The questions were difficult in some areas, and addressed different components, which made it possible to evaluate the mentees understanding. We could also see that the mentees had fun with the assignments, and it worked to engage the mentees and their newly learned tasks and it became a goal to manage the assignments at the end of the modules. However, we could see some exceptions and areas for improvements that need more research. These exceptions were visible when the questions were too easy and did not challenge the mentees to reflect upon new knowledge. These questions were changed in the revised edition that is presented in section 7.5.2, but we have not tested them.

Another improvement in this component can be to create questions that reinforce reflection. By doing so, a deeper understanding can be created for each module and the meaningfulness (Furnham, 2005), like explained in section 2.4.1. Another way to reinforce could be to make the mentors explain around the questions if it addresses motivation, structure and functions and practical exercises, to make communities of mentor practice, have systematic follow-up after someone has become mentors through this community and to give rewards for taking the course.

### **7.3.2 Structure of Basic user course**

So for the overall basic user courses we found that the training programme worked for beginners and more advanced users. That is, we saw that the overall themes in the basic user course worked as intended. Therefore the increased degree of difficulty for the mentees in each module worked to scaffold and build new knowledge, in order to cultivate them to

become future mentors. The exception to this is mentees with low computer skills, and we could see that they were dependant on having a mentor next to them, explaining each task step-by-step. In this case the mentors took over for the modules, and acted as scaffolds for the mentees. Here the mentors were the success factor in the training programme and showed us the importance of their role.

Another aspect we found was that the length on the modules worked well and that basic user level was divided into two courses. We experienced during the evaluation cycle that going through both basic user courses in one session, lasted to long in order for the mentees to maintain focus and they lost concentration in the last modules. This told us that it is wise to have two courses, and it should ideally not be taken in one session. Our recommendation is that the mentees take one course at a time.

The theory modules, especially the one introducing HMIS and DHIS 2, got little attention from the mentees during testing in the evaluation cycle. Since these modules were text based, without the practical exercises and the setting with us as researchers present, created time pressure with little room for reading. It is therefore difficult to conclude if these modules worked and is sufficient enough for meeting training needs. However, we observed that the indicator module seemed easy for the mentees. A solution for reinforcing these two modules could be to change the content. For the introduction course, one can make it shorter, more specific, and with more challenging assignments. For the indicator module one can strengthen the content to DHIS 2 indicators, and in that way make it more challenging. At this time we would not argue for removing these modules before more research has been done, using the e-learning app. This is because it is important that new beginners and novice users reads these modules to ensure their understanding for DHIS 2 and indicators.

## **7.4 Content mentor training**

We will now address how the content of the mentor courses should be structured in order to cultivate champions of DHIS 2 to become mentors.

### **7.4.1 Components in Mentor course**

From the evaluation cycle, we could see that the prerequisites component worked as intended, to prepare the sessions. We could see signs of preparations throughout the sessions, but not for all. Therefore, this component needs more testing and improvement on what should be prepared in order to see the usefulness. Our conclusion is that this component should remain in the courses, but it needs to be more tested in relation to the content.

The intention behind the component added value for the mentor and health management was to motivate the mentors in order for them to champion for DHIS 2 later on. However, there were no assignments addressing this component, meaning that we could not see any effect from it. Our conclusion is that this should be evaluated on level three and four, using Kirkpatrick, to see if the behaviour of the mentor has changed, or if this has an effect on the organisational level. We were not able to do this due to time constraints, and more testing should be done before dismissing it.

The component with guidelines worked as intended, to help the mentor facilitate reaction and articulation, which is guideline number seven in Quintana et al. (2004) scaffolding guidelines, see Table 1: Scaffolding design framework. We could see that some mentors used the guidelines in the mentor courses actively in the sessions and these clearly worked as help. This active use told us that the two mentor courses had a scaffolding effect for the mentors, and it eased the process management as explained in section 2.2, such as give expert guidance to the mentees for the different tasks (Quintana et al., 2004). This scaffolding effect for easing the expert guidance could also be observed in the sessions, where the mentors explained the steps thoroughly and gave feedback to the mentees according to the guidelines. These techniques on explaining steps and give feedback are also emphasized by Roscoe and Chi (2007) for effective mentoring. Our conclusion is to keep this component and to improve the content as one discovers new useful guidelines for the mentors.

Another component we could see worked was common errors, which was meant as a preparation for the mentor. This component is also emphasized in Grossman and Salas (2011), to give error management instructions to facilitate the proper use of targeted knowledge, as explained in section 2.4.2. Further, we observed during the training sessions that this component scaffolded the mentors in process management of training in non-salient routine tasks (Quintana et al., 2004), explained in section 2.2, Table 1. An example of when we could see this scaffolding effect was when the mentees entered data into the system, and met an orange number, meaning that this number is either too low or high according to the set min/max rules. Then the mentors needed to explain this common error and discuss this with the mentees. When bringing up common errors it also gave the mentees a larger understanding for the tasks, which is important in order to strengthen their problem solving competence (Kaasbøll, 2015). We could see the increased understanding through the mentees' answers in the quiz. Our conclusion is to keep the component and to add and improve the content as one detects more common errors.

For the component with assignments we tried to make an assignment where the mentee send a message writing issues that arise during the training, what they have learned, tips for other mentors and so on, in order to create a community of mentor practice. The structure of the mentor courses is that the mentor reads through the modules, conduct mentoring sessions with a colleague and then send a message to the mentor group after each module. The training sessions were not arranged so the mentor could send a message after each module, since they used one computer and the mentor could not interrupt the mentee during the sessions. Our recommendation is to change the structure of the mentor courses, so the mentor reads through the modules on course at a time, makes the necessary preparations, answer a quiz and then mentor others. After this training session, the mentor has to send a message to the mentor community with their reflections, tips for others and possible problems in order to proceed to the next course. In this way we remove the assignments that did not work, and replace this with a quiz to evaluate and reinforce that reading and preparations are done.

#### **7.4.2 Structure Mentor course**

So an overall conclusion is that we could see when testing the courses that the design of the modules had a focus on instructions for how to do a training session, and not content that would increase their knowledge and problem solving competence within DHIS 2. On the

other hand the courses can lead to scaffolding interactions, where the mentor and mentee finds the answer together. But since we could see that the mentors were uncertain in their role and did not have the sufficient knowledge to be confident in their role as mentors, there is a gap between the basic user level and the mentor level, as mentioned in section 7.1, that needs to be covered. The reason for this gap could be that the mentors did not have the time to go through the mentor courses properly and to let the new knowledge be processed and practiced afterwards. It is therefore necessary that the mentors have time to build their knowledge, and it takes time to develop expert domain knowledge (Roscoe and Chi, 2007). Another reason could be that the mentor courses did not cover enough or the right things to give the mentees sufficient knowledge to become mentors. A solution to this could be to implement a third level between the basic user courses and the mentor courses. In this way one can scaffold and build the mentees knowledge in their proximal zones of development to the sufficient level for becoming mentors. In the end of the mentor courses we gave a reward trough a diploma, and our conclusion is to keep this as an incentive for doing the courses, and for providing positive feedback.

## **7.5 Recommendations**

In the following section we will present our recommendations, based on our findings, analysis and discussions.

### **7.5.1 From the original to the revised edition**

Based on our findings and feedback from the exploration and evaluation cycle, our analysis, discussion and relevant literature we saw things in the e-learning courses we wanted to change, in order to make a revised edition available in resources within DHIS 2 and in the app when it is finished.

### **7.5.2 Basic user courses**

After the training sessions in the evaluation cycle, we could see that the Visualizer module contained too much information and material. We could also see that it was one thing to make a chart by selecting indicators, periods, organisation units, another was the favorite function, where one saves chart/tables and creates a good name. We therefore decided to split Visualizer into two modules, which now consists of Visualizer and favorites, see Figure 33 for an example of the new module. Since the dashboard function is where one can display



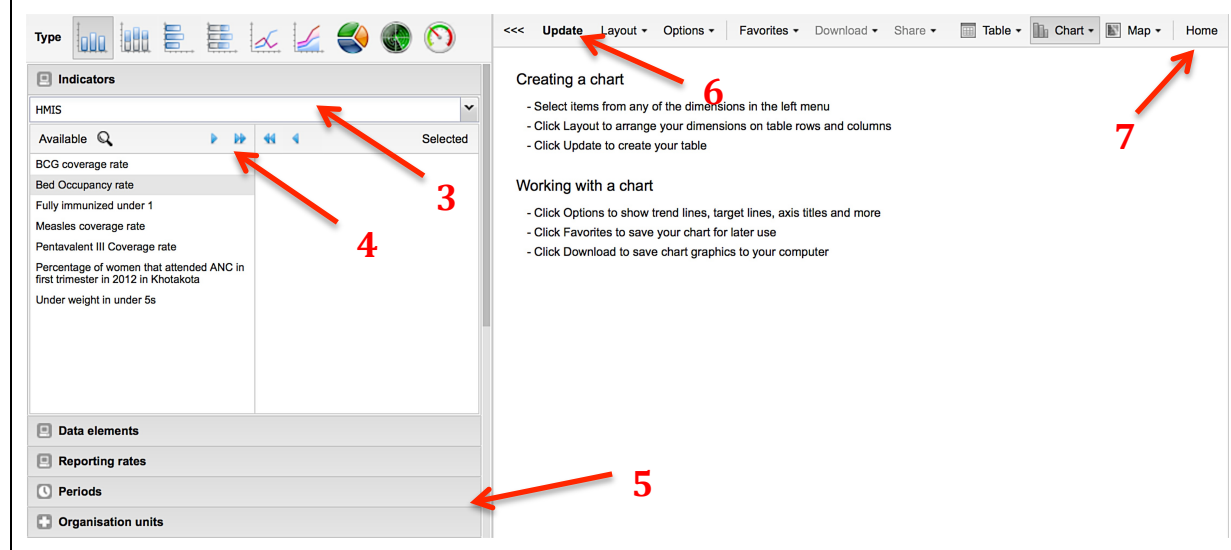
saved items from favorites, we wanted this module to be covered before the dashboard module. Since we already had decided to split Visualizer, we changed the sequence of the modules. In this way we did not have to change the Pivot Table module, and the explanation on how to save in favorites would be a short repetition in this module. The Pivot Table module can be seen in basic user course 2, Appendix E. Before the change, the sequence of the modules was Pivot Table and then Visualizer. Now it is Visualizer, favorites and then Pivot Table, see Table 11.

From	To
Pivot Tables	Visualizer
Visualizer	Favorites
	Pivot Table

**Table 11: Change of sequence in the modules**

In addition to this we implemented the “Home button” in the Visualizer module so the mentees learns how to navigate. This is because we could see during the training sessions that several struggled with navigating in the system. See Figure 30 for the new feature in Visualizer module.

- 3: Click on the indicator field and choose relevant indicator-group from the drop-down menu.
- 4: Mark the chosen indicator and use the single arrow to select. For selecting all indicators in the group, use the double arrow.
- 5: Choose relevant period and organisation unit for your analysis. If you want another period than ☒ Last 12 months , uncheck this choice.
- 6: Click on **Update** to create a chart.
- 7: Click on **Home** to return to the front-page.



**Figure 30: New feature in Visualizer module**

We also replaced some of the screenshots that were unclear and a more detailed explanation in some of the steps. The assignments that were easy were replaced with other questions. Assignment two in data validation because it was too trivial, see Figure 31, and were replaced with Figure 32.

**Assignment**

**2. What should one do when the data entry form doesn't pass through the run validation?**

- a) Push the complete button and ignore the warnings.
- b) Leave the Data entry app and do data entry later.
- c) Correct your data entry form and push run validation again.

**Figure 31: Original question Data Validation**

**Assignment**

**2. Which of the following is a data type?**

- a) Fractions
- b) Numbers
- c) Percentages

**Figure 32: Revised question Data Validation**

## 3. Favorites

### Motivation

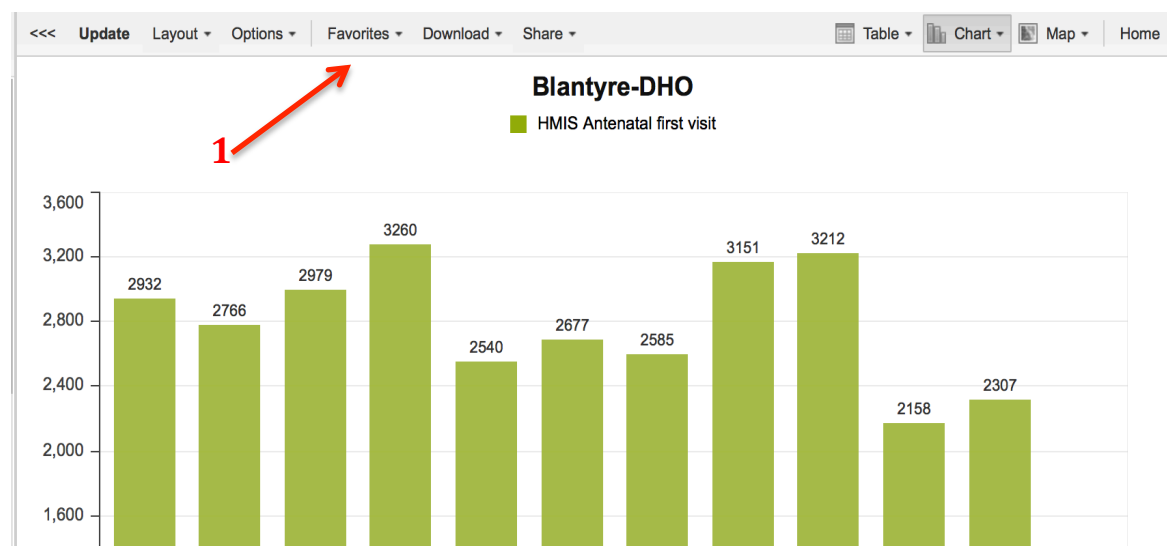
Favorites will make it easier to find previous work, and make overall analyses in your dashboard. This will also help collaboration with other colleagues by sharing and comparing results.

### Structure and functions

Favorites are a function where you can save your graphs and tables. This makes it accessible for yourself and other colleagues and can be used when you do your analyses. It can also be displayed on your dashboard.

### Practical exercise- Favorites

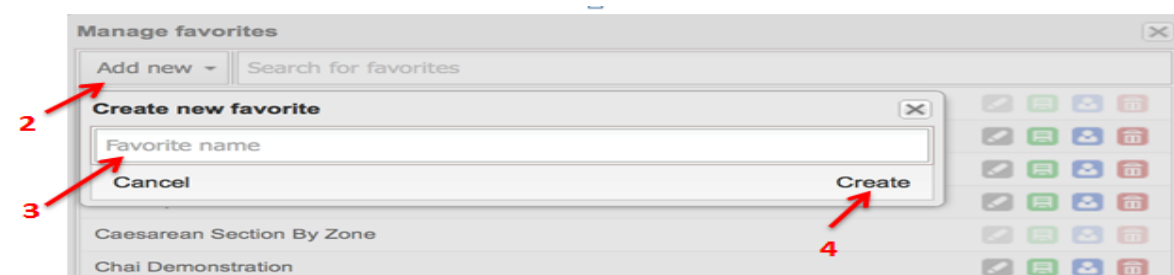
1: To save the chart or Pivot Table you have made, click on **Favorites**.



2: Click on **Add New**.

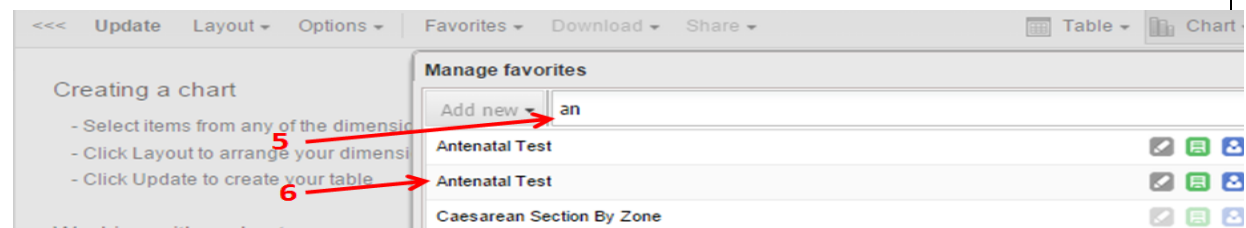
3: Give your chart/table a name. It will be wise to give your chart/table a name that you will remember later.

4: Click on **Create**. Your chart/table is now stored.



5: Click on **Favorites** and write the name of your chart/table.

6: Click on the name of your chart/table to open it.



## Assignments

### 1. A Favourite is ...

- a) A line chart.
- b) A chart stored for later use.
- c) The best chart in the system.

### 2. What is a good tip to remember when you name your chart/table?

- a) It is smart to name your chart/table after a system you remember for later.
- b) It is smart to name your chart/table after your colleagues so you remember it for later.
- c) It is smart to name your chart/table after your siblings.

### 3. How can you find and open your chart/ table again in the Visualizer?

- a) Click on the button **Update**.
- b) Click on **Favorites**, click on **Add**. Then write in the name on your chart/table in the search-field, and then click on the name.
- c) Click on **Favorites**, write in the name on your chart/table in the search-field, and then click on the name.

Figure 33: New module in the revised edition

### **7.5.3 Mentor courses**

We changed the sequence of the mentor courses, so they would follow the new sequence in the basic user courses. This means that the Visualizer module is now placed before Pivot Tables. We kept the original structure of the modules, since we saw through our findings that these partly worked. The component regarding added value for doing the module was also retained, despite we did not find any motivational effect. We could not measure the results, since there were no assignments addressing it and we did not evaluate learning on level three and four in Kirkpatrick's levels. This component will be kept in the courses, until it can be evaluated properly.

### **7.5.4 From Basic level to Mentor level**

During the mentor sessions we could see that the mentors struggled with the modules during the second basic course. A possible solution for covering the gap of knowledge and facilitate for suitable proximal zone of development for the mentees. This can be done through a third level that can be called the advanced level. In these courses one can have a more in-depth training where the mentees learn more problem solving. The tasks in this level should be more reflective and demanding, to raise the competence to a higher level. One can also implement a time limit for a mentee in between taking the different levels. For example one can say that a person has to work six months after completing the advanced level before he/she can start on the mentor level.

### **7.5.5 Advanced level**

We have made an example of how the advanced level could be designed, and this can be seen in Figure 34. The layout and structure of these modules will be different from the basic user courses. It will contain three components, and these are motivation, explanation and assignments. At this level it is expected that the mentee should know the structure and functions of the module and it is not included in the advanced level. Instead of the practical exercise, there is a component called explanation. This will give examples of the module to be taught, and following this is the assignments. In contrast to the basic user courses, there are different kinds of assignments in these modules focusing on problem solving.

# Layout Visualizer

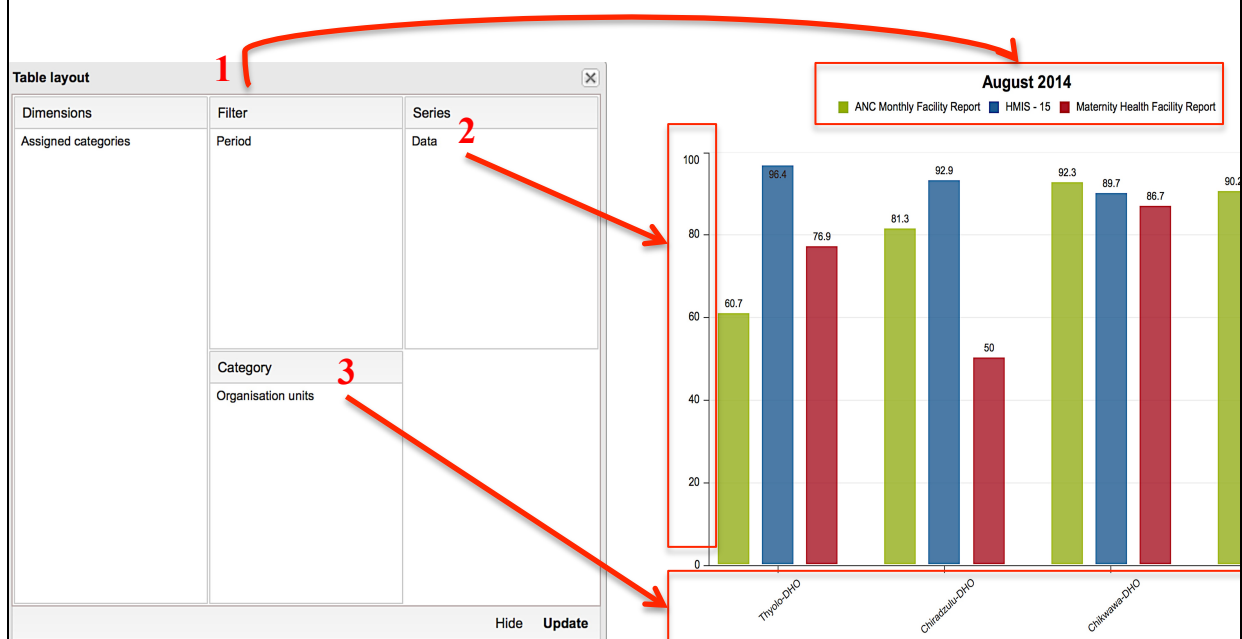
## Motivation

When you learn more about the layout function in the Visualizer you will be able to change and customize your chart.

## Explanation

1. By adding e.g. Period under **Filter**, it will show as the title in your graph.
2. By adding e.g. Data under **Series** it will appear on y-axis (vertical axis) in your chart.
3. By adding e.g. Organisation Units under **Category** it will appear on the x-axis (horizontally axis) in your chart.

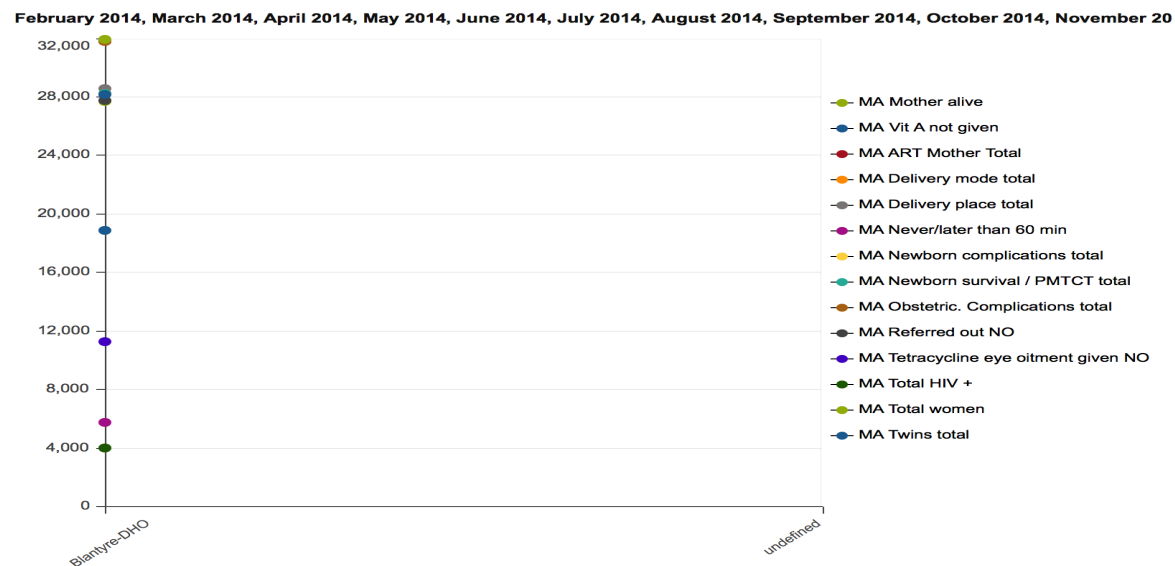
**Data:** Can include data elements, indicators and reporting rates.



## Assignment

1. Make a chart that compares the reporting rate for ANC Monthly Facility Report, HMIS - 15 and Maternity Health Facility Report in November 2014 for four different districts. Make the graph show all facilities in the x-axis in the chart. Save this chart in favorites and add it to your Dashboard.

2. This line chart looks weird, and does not show the trend over time. Why is this?



- There are no indicators available and they have been filtered.
- In Layout period is added under category and not series.
- In Layout period is added under series and not categories.

3. Pick a chart from the Favourites list. See what happens when you drag Period, Org. Unit and Data between Filter, Category and Series. Remember to click update after a change.

Figure 34: Example of a module from the advanced course

## **7.6 Research limitations**

During our study we encountered some limitations for our results. Since we travelled to Malawi to test our training programme there are constraints regarding evaluation of the long term affect for training. We could not evaluate the training on level three and four, behaviour and result, in Kirkpatrick's four levels of evaluation (Kaasbøll, 2015). These levels could have evaluated if the mentees use the various functions in DHIS 2 back at work and if the training has changed the organizational performance. Due to time constraints we could not evaluate these, and therefore it needs more research to see if it is a change in work performance, and transfer of our training has occurred.

## **7.7 Research contribution**

Through our study, we contribute in creating a training programme to cultivate local mentors. From our search in literature we have seen that mentors usually gets extra training in the relevant IT system, if there is any at all, in order to become a mentor. We have not found anything in the literature on how the mentor should help others, and conduct mentoring sessions. Our contribution is a suggestion for how the mentors should behave and what they should prepare. We could see from our study that the prerequisites, guidelines and common errors components helped the mentor conduct training sessions.

## **7.8 Further research**

During our work with this thesis we found some areas the needs more research on before one can make final conclusions. Some are areas that should be tested after the e-learning app is implemented, and one can do research on the intended use of the courses. This is areas' such as:

- When the app is implemented one should do more research on how much time a mentee should use before becoming a mentor. One should also test out the third level, which we have called advanced level.
- The theory modules should be tested within the app, to see if it has the desired learning effect.



- The assignments in the mentor modules should be changed so that they encourage reflection and evaluation on the mentees knowledge of new skills.
- More research should be done on the interactivity between the mentor and mentee, to ensure blended learning for sustainable learning effect for the training programme.
- More research on the advanced level to see if it covers the gap between basic user course and mentor course, and creates sufficient problem solving competence.



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# Appendix A: Ethical clearance

Norsk samfunnsvitenskapelig datatjeneste AS  
NORWEGIAN SOCIAL SCIENCE DATA SERVICES



Harald Hårfagres gate 29  
N-5007 Bergen  
Norway  
Tel: +47-55 58 21 17  
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Postboks 1080 Blindern  
0316 OSLO

Vår dato: 20.02.2015

Vår ref: 41957 / 3 / AMS

Deres dato:

Deres ref:

## TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 30.01.2015. Meldingen gjelder prosjektet:

41957	<i>eLearning Courses in DHIS2</i>
Behandlingsansvarlig	Universitetet i Oslo, ved institusjonens øverste leder
Daglig ansvarlig	Jens Kaasbøll
Student	Anniken Jønsson

Personvernombudet har vurdert prosjektet og finner at behandlingen av personopplysninger er meldepliktig i henhold til personopplysningsloven § 31. Behandlingen tilfredsstiller kravene i personopplysningsloven.

Personvernombudets vurdering forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, ombudets kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, <http://www.nsd.uib.no/personvern/meldeplikt/skjema.html>. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, <http://pvo.nsd.no/prosjekt>.

Personvernombudet vil ved prosjektets avslutning, 04.05.2015, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Katrine Utaaker Segadal

Anne-Mette Somby

Kontaktperson: Anne-Mette Somby tlf: 55 58 24 10

Vedlegg: Prosjektvurdering

*Dokumentet er elektronisk produsert og godkjent ved NSDs rutiner for elektronisk godkjenning.*

*Avdelingskontorer / District Offices*

OSLO: NSD, Universitetet i Oslo, Postboks 1055 Blindern, 0316 Oslo. Tel: +47-22 85 52 11. [nsd@uio.no](mailto:nsd@uio.no)

TRONDHEIM: NSD, Norges teknisk-naturvitenskapelige universitet, 7491 Trondheim. Tel: +47-73 59 19 07. [kyrre.svarva@svt.ntnu.no](mailto:kyrre.svarva@svt.ntnu.no)

TROMSØ: NSD, SVF, Universitetet i Tromsø, 9037 Tromsø. Tel: +47-77 64 43 36. [nsdmaa@svt.uit.no](mailto:nsdmaa@svt.uit.no)

# Appendix B: Questionnaire

Providing and receiving help on DHIS

01.05.15 13:41

## Providing and receiving help on DHIS

Be om redigeringstilgang

By filling this questionnaire, you help us improving the user support on DHIS.

### We will randomly draw one respondent who will be awarded with USD 100.

Your response to the questions will NOT affect your chances of being the lucky winner.

**If you want to take part in this lottery, please write your e-mail address here.**

If you have replied to this questionnaire before and want to take part in the lottery, just write your e-mail and do NOT fill the form again. Just click Continue to the last page and press Submit.

#### What is your main task concerning DHIS

- ☐ I enter data or view the output from the system.
- ☐ I am managing one of the organisational units where the system is used.
- ☐ I am in the team adapting the system or supporting users.

#### I receive help from others on using the system

1 2 3 4 5 6

Never ☐ ☐ ☐ ☐ ☐ ☐ Often

#### How satisfied are you with the help you receive from others?

1 2 3 4 5 6

Very unsatisfied ☐ ☐ ☐ ☐ ☐ ☐ Very satisfied

#### If you have participated in a training course on the system, how satisfied are you with the training?

1 2 3 4 5 6

Very unsatisfied ☐ ☐ ☐ ☐ ☐ ☐ Very satisfied

#### I give help to others on using the system

1 2 3 4 5 6

Never ☐ ☐ ☐ ☐ ☐ ☐ Often

## Providing and receiving help on DHIS

### Specific user roles

**My superiors have requested me to help others using DHIS**

- ☐ Yes  
☐ No

**I have received more training on DHIS than most other users.**

- ☐ Yes  
☐ No

**I am creating user accounts for others.**

- ☐ Yes  
☐ No  
☐ It is not possible to create new user accounts in this system.

**I am a Health Management Information System Officer**  
also called Statistician or HMIS focal person.

- ☐ Yes  
☐ No

**I am a clerk**

- ☐ Yes  
☐ No

**I am a health programme coordinator**  
also called programme manager

- ☐ Yes  
☐ No

Tilbake

Fortsett

50 % fullført

Drevet av

Dette innholdet er ikke laget eller godkjent av Google.

[Rapporter misbruk](#) - [Vilkår for bruk](#) - [Ytterligere vilkår](#)

## Providing and receiving help on DHIS

### Tasks for local DHIS support persons - superusers

The questions on this and the next page concern persons located close to you whom you ask for help on DHIS or other computer topics. We call these persons "superusers." It does not matter whether the person has a formal role as a superuser or if her/his role has just come about informally.

You can answer the questions regardless of whether there is a superuser at your place of work or not. Also, you can answer the questions regardless of which role you have concerning the system, and you can also answer them if you are a superuser yourself.

The question for this page is:

### To which extent should a superuser be able to ...

... argue convincingly for the purpose of the system towards other users?

1 2 3 4 5 6

No extent ☐ ☐ ☐ ☐ ☐ ☐ a large extent

... encourage other users to use the system?

1 2 3 4 5 6

No extent ☐ ☐ ☐ ☐ ☐ ☐ a large extent

... solve IT related problems?

1 2 3 4 5 6

No extent ☐ ☐ ☐ ☐ ☐ ☐ a large extent

... guide other users such that they become able to solve the particular problem themselves if the problem reappears in the future?

1 2 3 4 5 6

No extent ☐ ☐ ☐ ☐ ☐ ☐ a large extent

... guide other users such that they become able to solve other problems themselves?

1 2 3 4 5 6

No extent ☐ ☐ ☐ ☐ ☐ ☐ a large extent

... learn new IT solutions, changes, and updates?

1 2 3 4 5 6

No extent ☐ ☐ ☐ ☐ ☐ ☐ a large extent

... observe misfits between IT and business?

1 2 3 4 5 6

No extent ☐ ☐ ☐ ☐ ☐ ☐ a large extent

... carry out IT related tasks which other users don't want to do?

1 2 3 4 5 6

No extent ☐ ☐ ☐ ☐ ☐ ☐ a large extent

... communicate with IT people?

1 2 3 4 5 6

No extent ☐ ☐ ☐ ☐ ☐ ☐ a large extent

... achieve social ties with others?

1 2 3 4 5 6

No extent ☐ ☐ ☐ ☐ ☐ ☐ a large extent

... achieve trust from others?

1 2 3 4 5 6

No extent ☐ ☐ ☐ ☐ ☐ ☐ a large extent

... do other tasks, please write them here:

Tilbake

Fortsett

75 % fullført

Drevet av

Dette innholdet er ikke laget eller godkjent av Google.

[Rapporter misbruk](#) - [Vilkår for bruk](#) - [Ytterligere vilkår](#)

## Providing and receiving help on DHIS

### How should superusers learn the abilities you deemed they should have?

**They should receive specific training on the superuser role.**

1 2 3 4 5 6

Not at all ☐ ☐ ☐ ☐ ☐ ☐ a lot

**They should be coached on the job by support people from the IT department.**

1 2 3 4 5 6

Not at all ☐ ☐ ☐ ☐ ☐ ☐ a lot

**They should communicate with IT support.**

1 2 3 4 5 6

Not at all ☐ ☐ ☐ ☐ ☐ ☐ a lot

**They should communicate with other superusers.**

1 2 3 4 5 6

Not at all ☐ ☐ ☐ ☐ ☐ ☐ a lot

**They should read user documentation.**

1 2 3 4 5 6

Not at all ☐ ☐ ☐ ☐ ☐ ☐ a lot

**They should read help which is embedded in the software.**

1 2 3 4 5 6

Not at all ☐ ☐ ☐ ☐ ☐ ☐ a lot

**They should explore all parts of DHIS**

1 2 3 4 5 6

Not at all ☐ ☐ ☐ ☐ ☐ ☐ a lot

**They should discuss the quality of their support with those whom they help.**

1 2 3 4 5 6

Not at all ☐ ☐ ☐ ☐ ☐ ☐ a lot

**in other ways, please write them here:**

Tilbake

Send

Send aldri passord via Google Skjemaer.

100%: Du greide det.

Drevet av

Dette innholdet er ikke laget eller godkjent av Google.

[Rapporter misbruk](#) - [Vilkår for bruk](#) - [Ytterligere vilkår](#)

# Appendix C: Interview guide

## Introduction phase:

1. Explanation of why we are doing this interview and who we are
2. What is your role/position?
3. Do you use DHIS2?
4. Why do you do that? Or why don't you use it?
5. Do you register data?
6. Do you make reports from the system?
7. Can you show us?
8. Who submits the data?
9. Have you participated in a training course?
10. How satisfied are you with this?
11. What do you do when you suspect that the data you receive is wrong?

## DHIS 2 training:

1. Do you help others?
2. Do you like helping others?
3. Do you feel that this is a part of your job?
4. What usually happens after a training course / do you get any follow-up?
5. Where can you find help to solve problems?
6. Do you have contact with those seated centrally? To what extent?
7. How do you keep in contact with them?
8. Do you have contact with other HMIS officers?
9. How do you keep in contact?

## DHIS 2 relations:

1. What is your relationship to the program coordinator?
2. What is your relationship with the district health manager?
3. Do program coordinators use the system? Why/why not?
4. Do you meet any resistance, and if so, what kind of resistance?
5. What do you think the HMIS officer can do to influence people to use DHIS2?
6. What do you think can get the interest up in regards to using DHIS2?
7. What can we (outside) help with?



8. What do you think the HMIS officer/Program coordinator/Clerk should do?

**Practical assignment: DASHBOARD**

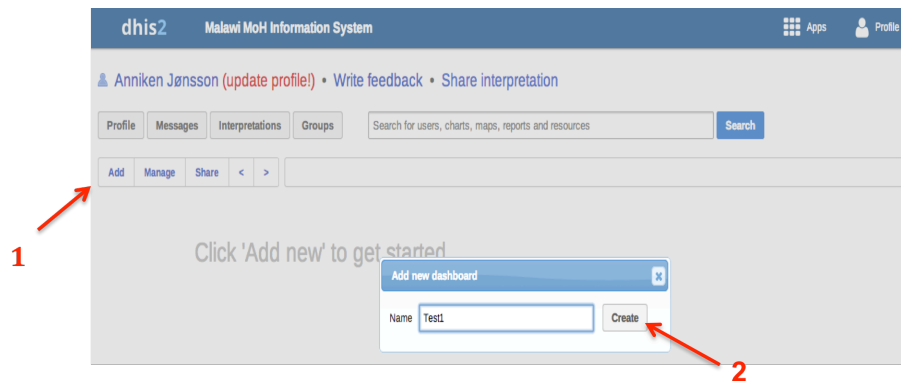
- Suggestion to Dashboard: HMIS15 sheet/form
1. Make the HMIS officer put up a Dashboard alone, for example ANC. This is to convince that this is useful.
  2. Is this a part of your tasks to do this?
  3. How much support do you receive from coordinators and managers to do this?
  4. What kind of resistance do you encounter?

# Appendix D: First design of modules

## DASHBOARD

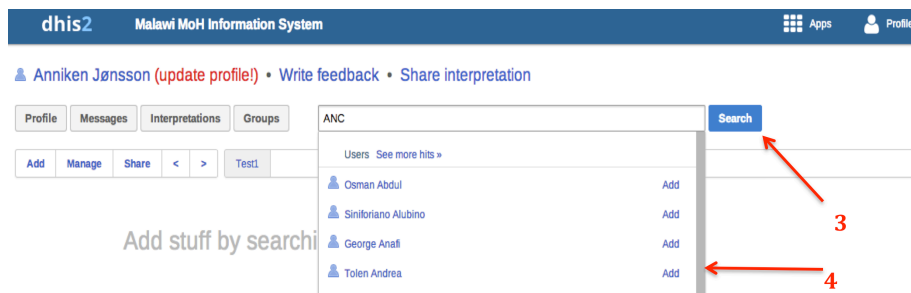
1: Click on add

2: Name your dashboard and enter create

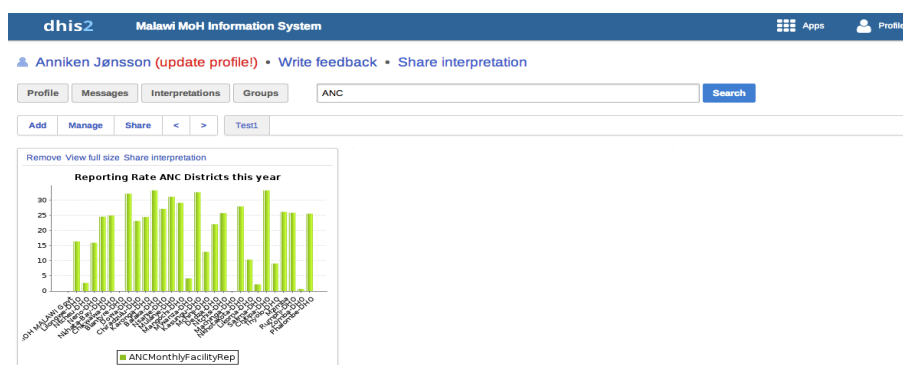


3: Search relevant users, charts, pivot tables, standard reports etc.

4: Click add to add it to dashboard

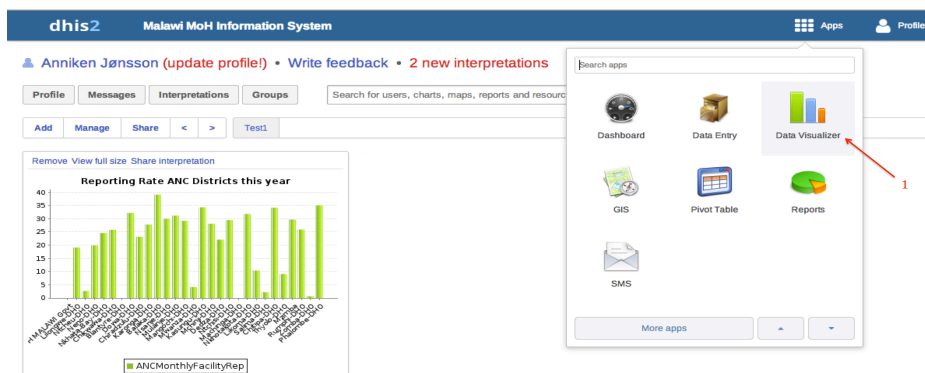


You have now created a dashboard with chosen table



## VISUALIZER

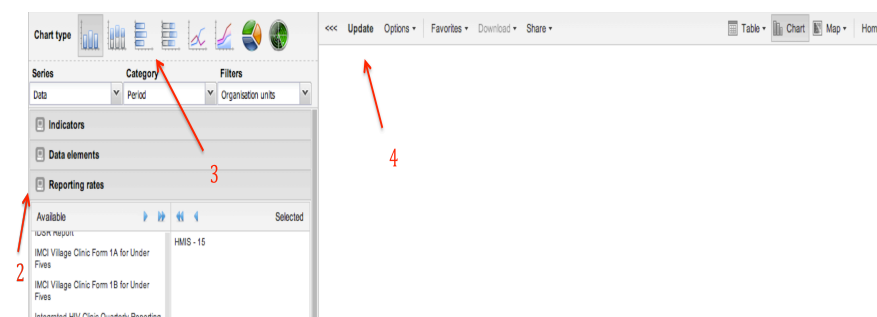
1: Go to visualizer.



2: Choose relevant indicators, data elements etc. for chart.

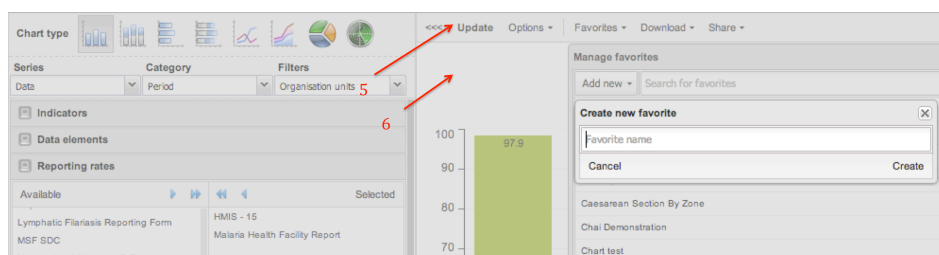
3: Choose the desired chart type.

4: Click on update to create the chart.

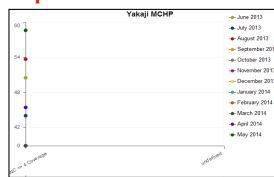


5: To store chart, click on favorites.

6: Click on add new, choose name and click on create. The chart is now stored and you can search for it in the search field to add it to your dashboard.



### Graph looks weird



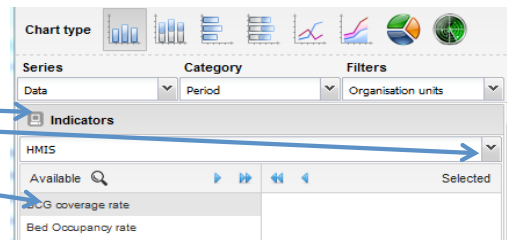
You have chosen Period in Series (Y-axis).

1. Exchange Period and Data in Series (Y-axis) and Category (X-axis)
2. Click Update



### No Indicators are available

1. Click Indicators
2. Click Down-arrow to select an indicator group
3. Select your programme or HMIS for common indicators
4. Select indicators by **DOUBLE**-click  
(or single click and use the small, blue right and left arrows)



### I need another title of the graph

1. Click Options  
(You will find several other layout options there also)



### The general way of improving charts

1. Make **one** change
2. Click **Update**
3. Repeat

# Appendix E: E-learning courses

## eLearning courses in DHIS2



Ellen Bjørge, Anniken Jønsson and Jens

Johan Kaasbøll

20.11.2014

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## Course 1: User level

### 1. Introduction to HMIS and DHIS2

#### HMIS

Health management information systems (HMIS) deal with aggregated data to make health management easier. Knowing that the immunization coverage in Riverside is 93% while it is 59% in Mountain View tells the immunization manager that a serious intervention is needed in Mountain View, while Riverside just needs to be praised. HMIS replaces older systems like Excel sheets, and stores all data within one system;

*“better information, better decisions, better health”.*

#### DHIS2

DHIS2 stands for District Health Information Software. DHIS2 is a tool for collection, validation, analysis, and presentation of data. It is web-based in contrast to version 1 predecessor which was a standalone Microsoft Access application. It is mostly tailored (but not limited) to integrated health information system (HIS) management activities. It is a generic tool rather than a pre-configured database application. DHIS2 is also a free and open source software.

The DHIS2 vision is:

*“ To support the development of an excellent and sustainable health information system that enables all health workers to use their own information to improve coverage and quality of health care within our community”*

#### Some key features are

- Provide a comprehensive HIS solution which can easily be customized to the different needs of the health systems for instance the DHIS2 can be used to capture aggregated data
- Provide data entry tools, which can either be in the form of standard lists or tables or can be customized to replicate paper forms.
- Provide different kinds of tools for data validation and improvement of data quality.

- Provide easy to use - one-click reports with charts and tables for selected indicators or summary reports using the design of the data collection tools.
- A user-specific dashboard for quick access to the relevant monitoring and evaluation tools including indicator charts and links to favourite reports, maps and other key resources in the system.

In summary, DHIS2 provides a comprehensive HIS solution for the reporting and analysis needs of health information users at all levels.

### **Assignments**

#### **1. What is the purpose with HMIS systems?**

- a) To collect patient data and make health management easier.
- b) To collect aggregated data and make health management more confusing.
- c) To collect aggregated data and make health management easier.

#### **2. What is part of the vision of DHIS2?**

- a) To save money and have more central control to improve health services.
- b) To support the development of an excellent and sustainable health information system.
- c) To improve health care services in some districts and give central authorities more control.

#### **3. Which of these choices is a key feature in DHIS2?**

- a) Provide different kinds of tools for data validation and improvement of data quality.
- b) To give health advices.
- c) Provide a vaccine program for Malaria for children over five year.



## 2. Data Entry

### Motivation

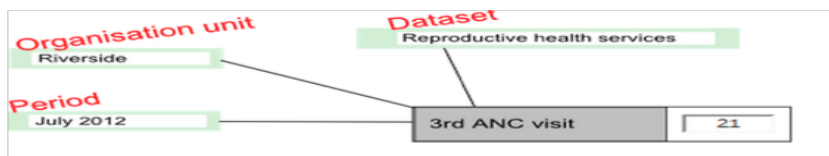
Data entry is the starting point for the entire system; if no data is entered, there is no data in the system to be analysed. When you enter data in DHIS2, the system can be used to make analysis more effective, improve data quality, make reports and enable comparison of data across time and place.

### Structure and functions

Data are entered into the system as data sets, which correspond to reporting forms filled out in health facilities. For example is the HMIS 15- data set, which includes core health data.

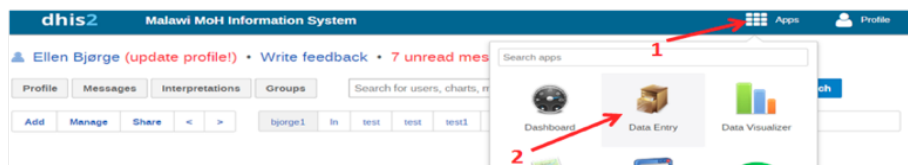
If data is entered while there is an interruption to Internet connectivity, the data is stored locally in the computer. When Internet connectivity is available, the data will be uploaded to the online server automatically. So don't switch off the computer until you are online again.

**Data set:** The data set is associated with a period (when) and an Organisation unit (where).



### Practical exercise- Data Entry

- 1: Click on the **Apps** button up at the right on the screen.
- 2: Click the **Data Entry** button as the arrow shows.



- 3: Click + once to move down.



- 4: Single click on the name of your organization unit to select it.

- 5: Your selected organisation unit is displayed on the main window of the data entry screen.
- 6: Choose the data set to fill in your data from the **Data Set** dropdown list.
- 7: Select wanted year.
- 8: Choose the period you want to enter data for from the “period” dropdown list.

- 9: Fill out the form.
- 10: When you are finished, click on the **Complete** button.

### Assignment

1. Why should you enter data into the system?
  - a) To make analysis of data more effective.
  - b) There is no need to enter data in the system.
  - c) To make health decisions more ineffective.
2. A number which you have entered in DHIS2 belongs to
  - a) A manager, a data entry clerk and an organisation unit.
  - b) A Country, an organisation unit and a period.
  - c) An organisation unit, a period and a data set.
3. How do one choose correct organisation unit?
  - a) Double click on the + sign.
  - b) Single click on the + sign and single click on your selected unit.
  - c) Write the name of the organisation unit in the organisation unit field.

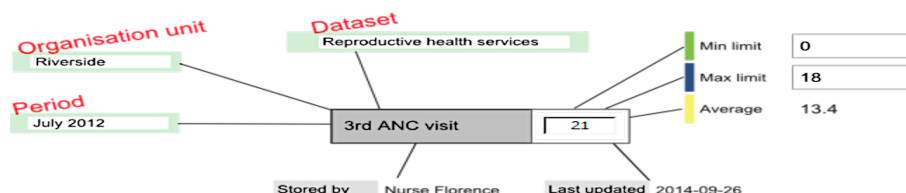
### 3. Min / Max data validation check

#### Motivation

To work towards a high degree of data quality will help ensuring the trust and use of the entire system. I.e. when data quality is good, decisions made based on these data will be better and that will again affect the quality of the health services provided on national, district and clinical level. It is therefore important to understand and know how to run data validation checks within the system.

#### Structure and components

In DHIS2 there are different functions for validating data and one of these are the min/max range values. These are defined for a specific organisation unit and fields.



#### Practical exercise - Min/max Validations

1: Enter your data in the **Data Entry** form.

1

2: If a min/max value has been defined for this specific field, a pop-up message will notify you automatically when you have a range that is either higher or lower than the predefined settings. The field will then have the colour orange to indicate that it might be incorrect.

2

If you double-click the field of data entry, a data information window will open.

- 3: Here the min/max range is shown, and we can also see the average value.
- 4: Data history is shown. This is a capture of the last 12 values that have been entered for this value. With this chart you can spot values that are higher, or lower than normal.
- 5: If you single-click the star button it will change colour and the value is marked for Follow-up. This allows that a suspicious/questionable value is kept in the system, but needs to be further investigated. This is used in conjunction with the Comment field. Always leave a comment on why you have marked a value.



**Note: One must always question the data and see if there is a valid reason behind gaps or sudden changes in numbers before writing it off as an error.**

#### Assignment

1. **What happens when the number entered into the system is over the maximum limit?**
  - a) An error will appear and the field will turn colour orange.
  - b) Nothing happens and you can continue entering data.
  - c) An error will appear and the field will turn colour green.
2. **What is important to notice when entering data into the system?**
  - a) To enter all data immediately and ignore all warnings.
  - b) To follow up gaps and deviations in range.
  - c) To ignore gaps/ empty spaces in the form.
3. **What should one do when commenting deviation with unknown reason?**
  - a) Don't mark the star, comment and do follow up.
  - b) Mark the star, make a comment, and do follow up.
  - c) Mark the star and make a comment.

## 4. Data Validation: Data type validation and common errors

### Motivation

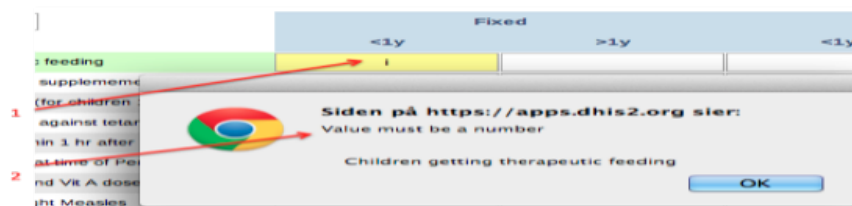
Validation of data entered is essential for the system to work as intended. If this job is done well the analysis of the data afterwards get more correct results and this leads to better decisions to improve health care and services in your area.

### Structure and function

In addition to the min/max validation check, DHIS2 has data validation functions such as data type validation, data validation for common errors, and commenting deviations. Data fields can be of types number, text, Yes/No, etc. Letters in number fields are invalid.

### Practical exercise - Data type validation

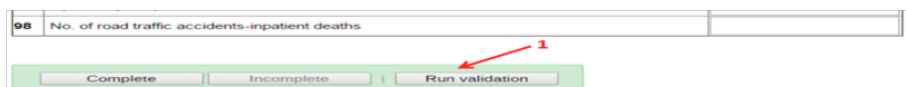
- 1: Enter your data in the **Data Entry** form.
- 2: If you type an invalid value, a pop-up message will occur when you want to go to the next field.



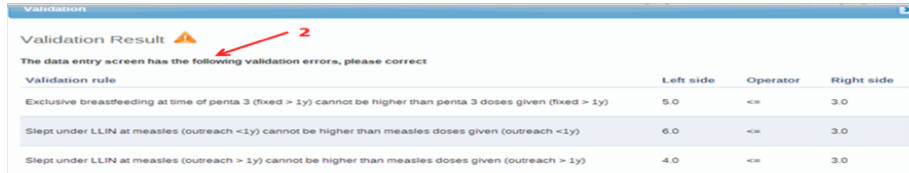
Until you have corrected the invalid value, the field will stay yellow.


### Practical exercise - Data validation for common errors

- 1: When you have filled out the form click the button **Run validation**. Then all predefined validation rules which involve data elements in the current form (dataset) will be run against the new data.



2: If there are data violations, you will be provided with a list of the rules that have been violated. Correct your data entry form and click the button **Run validation** again.

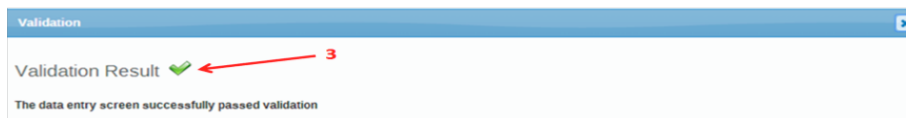


Validation Result  2

The data entry screen has the following validation errors, please correct

Validation rule	Left side	Operator	Right side
Exclusive breastfeeding at time of penta 3 (fixed > 1y) cannot be higher than penta 3 doses given (fixed > 1y)	5.0	<=	3.0
Slept under LLIN at measles (outreach < 1y) cannot be higher than measles doses given (outreach < 1y)	6.0	<=	3.0
Slept under LLIN at measles (outreach > 1y) cannot be higher than measles doses given (outreach > 1y)	4.0	<=	3.0

3: Then if none of the data values violated the validation rules, you'll receive a message that the data entry screen successfully passed validation.



### Assignment

1. **Why is data validation important?**
  - a) To get incorrect data out of the system.
  - b) To complete the data entry form.
  - c) To get accurate data, so well informed decisions can be made.
2. **What should one do when the data entry form doesn't pass through the run validation?**
  - a) Push the complete button and ignore the warnings.
  - b) Leave the Data entry app and do data entry later.
  - c) Correct your data entry form and push run validation again.
3. **What should one do when finished filling out the data entry form and all follow up is done?**
  - a) Leave the data entry app without pushing the complete button.
  - b) Go straight to fetch the data set report.
  - c) Push the complete button to be submitted for sign-off reporting.

## 5. Data Set report

### Motivation

Data set reports enable print and export to Excel of Data sets. Both facility data and data aggregated at district and higher levels is available.

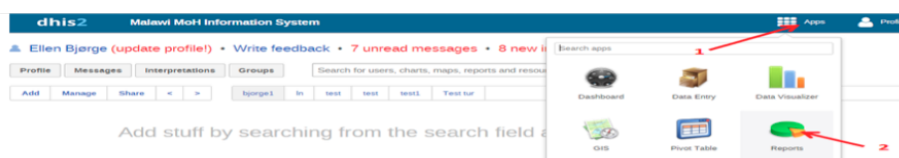
### Structure and functions

In Excel, data input and output takes place in the same window. In DHIS2, *input* is done in the Data Entry form, while *output* is done through Reports; standard reports, data set reports, reporting rate summary, organisation unit report, data approval, report table, pivot tables, graphs and maps.

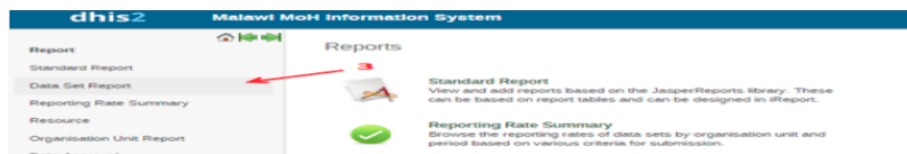
Another difference from Excel is that data entered in DHIS2 needs to be processed by the server before it can be retrieved in reports. This processing happens at night. The data you entered will therefore only be available in reports the day after data entry.

### Practical exercise - Data set reports

1. Click on the **Apps** button.
2. Click the **Reports** button.



3. In the left pane of the screen, click on **Data Set Report** to enter the data set reports.



4. Choose relevant data set
5. Choose relevant frequency of period
6. Select wanted year. If one chooses monthly above, select wanted month

7. Select organisation unit by using the plus/minus button until you find relevant unit, then mark it orange by clicking on the name.
8. Push **Get report** to create the data set report.

9: You can download your report as an Excel sheet, PDF-file or print by a single-click on these buttons.

## Assignment

1. **What is the difference between data input and output in DHIS2?**
  - a. Output is typing the numbers in the Data entry form.
  - b. Output is retrieved from reports, while input is through Data entry.
  - c. Input is done through Data entry, and output consists of exporting Data entry to Excel
2. **What is a data set report?**
  - a. The same as the data entry form.
  - b. Facility data and aggregated data at district and higher levels.
  - c. Facility data and patient data at district and higher levels.
3. **How do you choose report period?**
  - a. Click on get report
  - b. Choose year and then frequency.
  - c. Choose frequency and then year.



## Course 2: User level

### 1. Indicators

#### Motivation

In order to see where efforts are needed, we need to compare performance against targets. If the target is 85% immunisation coverage, it is not enough to know that we have vaccinated 900 children; we also need to know how many children we should have vaccinated. To get the percentage, we divide the number of immunised (900) with the number of children under 1 year (1000) and multiply with 100, and we get the coverage rate 90%. In DHIS2 the indicators like immunisation coverage are calculated for you; you only have to choose the relevant indicator and know how to create a report, chart or pivot table to show the result. However, it's important to know the basics about indicators and how to calculate them, such that you understand the output from DHIS2.

#### Structure and functions

First a definition: *"Indicators are variables that help to measure changes, directly or indirectly"* (WHO, 1981). So, the indicators *"show a given situation, and thus can be used to measure change"* (Green, 1992). For example a baby's weight for age is an indicator of the baby's nutritional status. Indicators are often calculated through two numbers called:

**Nominator:** is a count of the events that are being measured; for example new cases of TB, number of doctors etc.

**Denominator:** is the group with which the things we count are compared; for example total population, total of health centres, total of births in a year etc.

Further, there are three main types of indicators in the DHIS2;

**Proportion indicator:** the numerator is contained in the denominator; its resultant values are often expressed as a percentage. For example the proportion of health centres in a country without ivermectin is:

$$\frac{\text{number of health centres without ivermectin (Numerator)}}{\text{total number of health centres (Denominator)}} * 100 \quad \text{Or,} \quad \frac{150}{2000} * 100 = 7,5\%$$

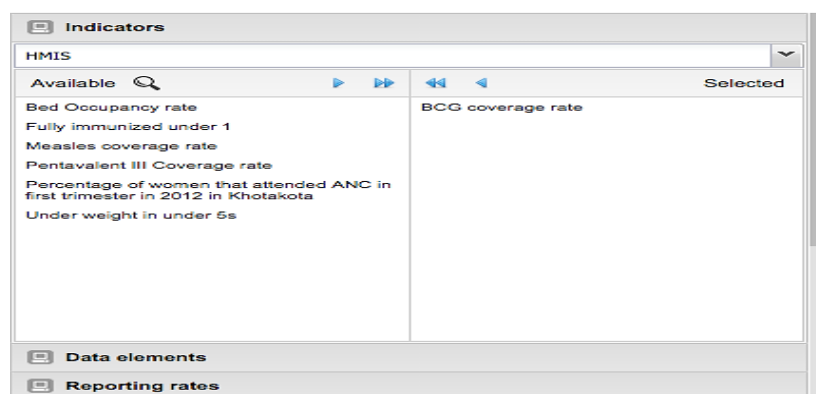
**Rate indicator:** the frequency of the event in a specific time in a given population; usually expressed per 1000 or 100 000 population. For example incidence of malaria cases in children <5 year in a country per year, and per 1000 children < 5 are:

$$\frac{\text{number of cases of malaria in children under 5}}{\text{population of children under 5 per year}} * 1000 \quad \text{or,} \quad \frac{10000}{600000} * 1000 = 16,7$$

**Ratio indicator:** Numerator is not included in the denominator. For example the ratios of male AIDS deaths in comparison to female are:

$$\frac{\text{number of male AIDS deaths}}{\text{number of female AIDS deaths}} \quad \text{Or,} \quad \frac{450}{350} = 1, 3 \text{ male deaths per female.}$$

These indicators will DHIS 2 calculate for you when you generate a pivot table or a chart. An example of indicators that you can choose from in DHIS 2, can be illustrated like this:



From the figure you see HMIS indicators where you have chosen BCG coverage rate when you are going to generate a pivot table or a chart.

### Assignment

#### 1. Why do we need indicators?

- To be able to compare health service performance.
- To add data from many facilities into a total.
- To export data into an Excel-sheet.

#### 2. What is the correct calculation of the indicator ANC visits in first trimester?

- $\frac{\text{number of mothers coming for their first ANC visit in their first trimester}}{\text{total population}} * 100$
- $\frac{\text{number of pregnant women}}{\text{number of mothers coming for their first ANC visit in their first trimester}} * 100$
- $\frac{\text{number of mothers coming for their first ANC visit in their first trimester}}{\text{number of pregnant women}} * 100$

#### 3. What is a nominator?

- The group, which the things we count are compared.
- Count of events that are being measured.
- Count of events that are being compared.

## 2. Pivot table

### Motivation

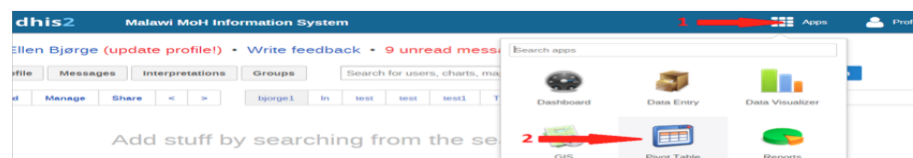
The pivot table is a tool for analysing data, which is the core of this system. This is a flexible tool for you as a user to do your own analysis that is relevant, in contrast to a data set report, which is more rigid. So, when you learn this tool you're able to do all kinds of analysis to really understand the situation in your district. One can also add it on your dashboard to create an overview.

### Structure and functions

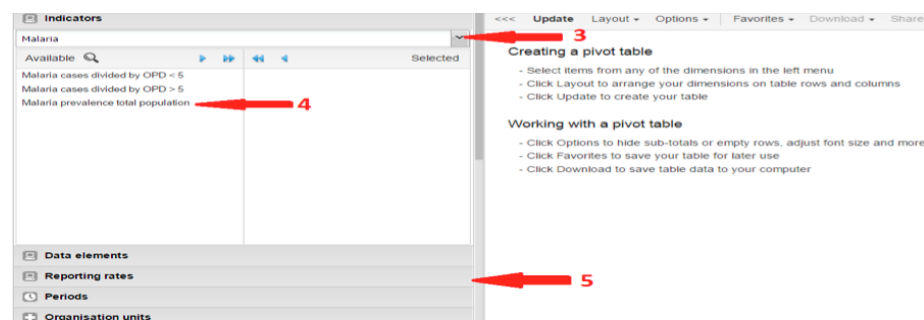
A Data element is a specific item in a Data entry form. Reporting rate is the percentage of completed reports. A pivot table is a spreadsheet with row and columns being Indicators, Data elements, Reporting rates, Periods or Organisation units.

### Practical exercise- Pivot table

- 1: Click on the **Apps** button.
- 2: Click on the **Pivot Table** button.



- 3: Choose indicator group.
- 4: Choose indicator by moving it from left (available) to right (selected).
- 5: Choose period and organisation unit.



6: Click **Update** when done.

7: If you are unhappy with your selection of items in row nans columns, Choose **Layout**

8: To save the table, click on **Favourites**. Click on **Add new**, choose name and click on **Create**.

The table is now saved and you can search for it in the search field to add it to your dashboard

	2010	2011	2012	October 2013	Total
Malaria cases divided by OPD < 5 s		214.7	382.5		214.7

**Layout:** Rows and columns are determined by the layout. It can be illustrated like this:

**Table layout**

Dimensions	Filter	Column
Assigned categories		
Row		
Organisation units		
Periods		

		BCG coverage rate	Measles coverage rate
Dona-DHO	January 2014	79.4	63.2
	February 2014	76.1	68.5
	March 2014	65.7	54.4
	April 2014	66.9	56.9
	May 2014	66.3	53.1
	June 2014	65.4	64.5
	January 2014	76.7	51.8

## Assignment

### 1. Why should you learn to make a pivot table?

- To understand why you should learn to do data entry in the DHIS 2.
- To understand how to do analysis of aggregated data within the DHIS 2.
- To understand how to do analysis manually.

### 2. How do you choose an indicator?

- Go to data element- field on the left side on the screen and select relevant indicator.
- Choose relevant indicator on the left side on the screen under the indicator field.
- Go to data entry app to find indicators

### 3. How do you choose layout?

- To download to an excel-sheet and make a pivot table where you can select column and row.
- Click the button layout and select what goes where.
- It is not possible to change layout.

### 3. Visualizer

#### Motivation

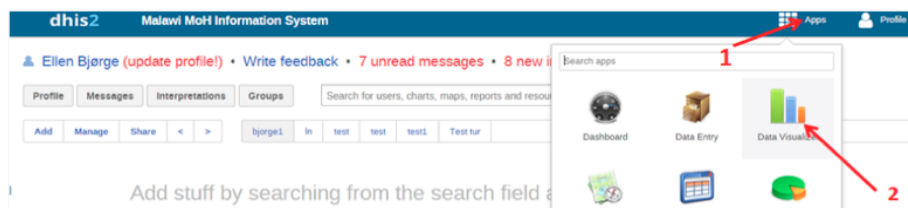
The visualizer is an analyzing tool that makes it easier to analyze specific issues and compare them across time and place. It also makes analyzing easier on national and international level since all data is gathered in the same system. All this contributes for better decision-making that has a positive effect on health care services provided.

#### Structure and functions

The visualizer is a tool for analysis that enables the user to easily get answers to different questions. The result can be presented in tables, charts etc.

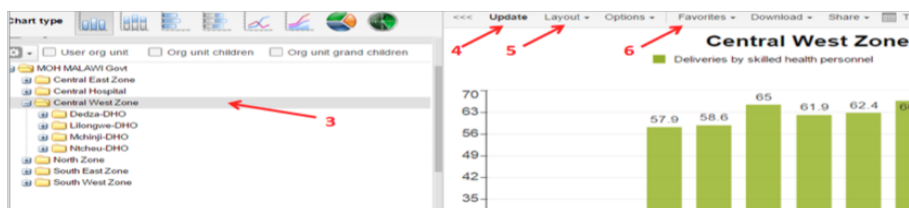
#### Practical exercise- Visualizer

- 1: Click on the **Apps** button.
- 2: Click on the **Data Visualizer** button.



- 3: Choose relevant indicators, data elements periods, organisation unit. for your analysis.
- 4: Click on **Update** to create a chart.
- 5: Choose **Layout** if wanted.
- 6: To save the chart, click on **Favourites**. Click on add new, choose name and click on create.

The chart is now saved and you can search for it in the search field to add it to your dashboard



## Assignment

### 1. Why learn to use the visualizer?

- a) The visualizer makes it easier to analyse specific issues and compare them across time and place
- b) The visualizer makes it easier to do data entry.
- c) The visualizer makes it easier to analyse specific issues in excel sheets and compare them across time and place

### 2. How do one choose correct organization unit?

- a) Go to **Periods** in the menu on the left side of the screen, and select the correct organisation unit.
- b) Go to **Organisation units** in the menu on the left side of the screen, and select the correct organisation unit.
- c) Go to **Indicators** in the menu on the left side of the screen, and select the correct organisation unit.

### 3. How do you create a chart?

- a) Choose period, indicator and organisation unit, and click on the button **Update**.
- b) Download data to Excel and create the chart there.
- c) Choose period and organisation unit, and click on the button **Update**.

## 4. Dashboard

### Motivation

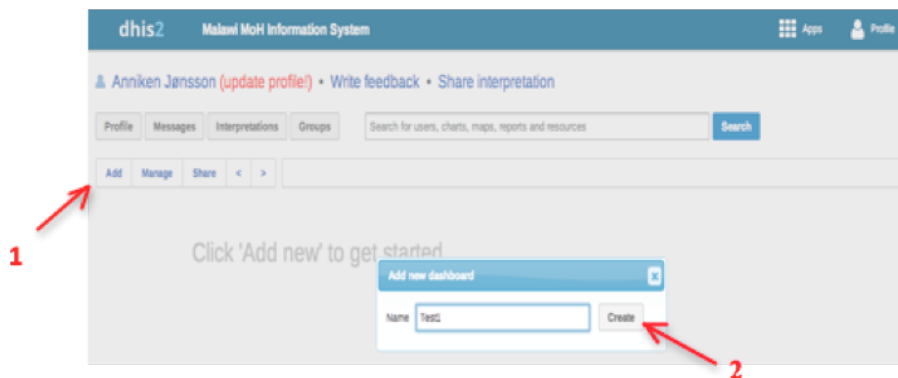
A dashboard is essential to have an overview over the different analysis. This dashboard can be personal or shared. It is therefore a good tool for cooperation where one can exchange knowledge and compare between districts etc. The dashboard you create here is personal until you decide to share it.

### Structure and functions

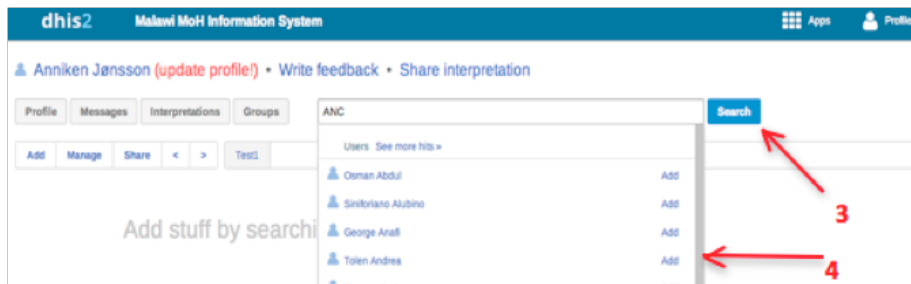
The Dashboard consists of several kinds of objects like feedback, interpretations, charts, tables and other resources.

### Dashboard step-by-step:

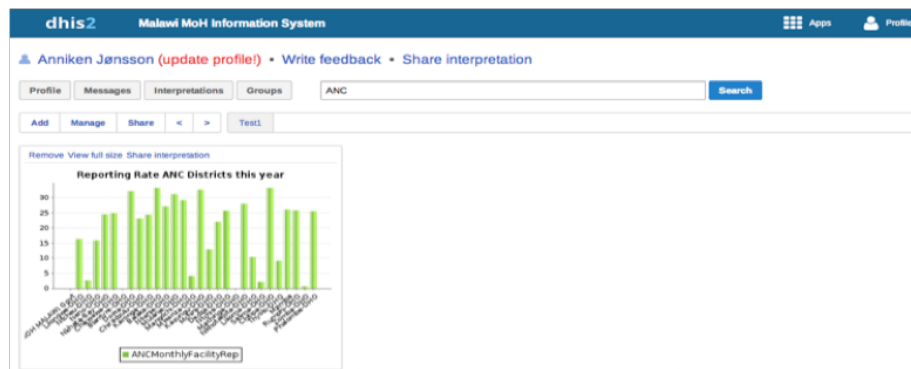
- 1: Click on **Add**.
- 2: Name your dashboard and click on **Create**.



- 3: Search relevant users, charts, pivot tables, standard reports etc.
- 4: Click **Add** to add it to dashboard.



You have now created a dashboard with chosen table



### Assignment

#### 1. Why should you make a dashboard?

- A dashboard is essential to have an overview of stored family pictures.
- A dashboard is essential to have an overview over the different data entry forms.
- A dashboard is essential to have an overview over the different analysis

#### 2. How do you create a dashboard?

- Click on **Share** and name your dashboard
- Go to **Apps** and click on the **Dashboard** button.
- Click on **Add** and name your dashboard

#### 3. How can you add a chart to your dashboard?

- Go to **Visualizer** and search for your chart on favourites and click add to add it to dashboard.
- Go to messages to search for your chart.
- Search relevant chart in the search field, then click **Add** to add it to dashboard.



## 5. Messaging

### Motivation

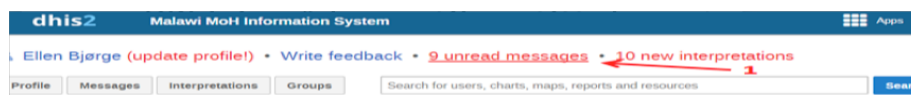
Messaging with colleagues will create essential cooperation in exchanging knowledge and ideas, solve problems and so on. You can ask questions, discuss and see ideas from others. This again will improve the overall knowledge about the DHIS2 that will have a positive effect on the health services provided.

### Structure and functions

Some functions with messaging are that you have an inbox, can write messages, do follow up, send to a specific user and to a group (district, facility ) etc. This function is for messages about results, the system etc.; not private messages.

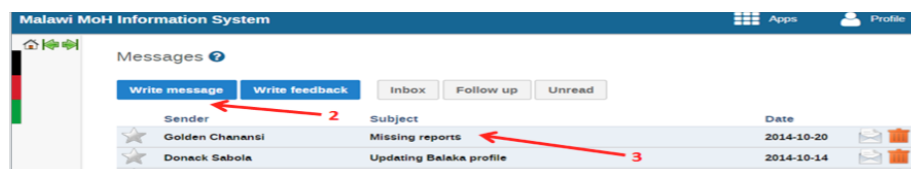
### Practical exercise- Messaging

1: Click on **Unread messages** to enter the area for messages.



2: Click on a message to read received messages.

3: Click on **Write message** to write and send a new message.



4: Click on dashboard or other areas in this menu to return there.

5: Choose relevant organisation unit you want to show this message for by clicking on the + buttons.

6: When you have found your unit click to mark it.

7: Write in specific user or groups if you want them to see this message.

8: Write in relevant subject/ heading or the message.

9: Write the message in this text-field.

**Write new message**

Organisation Unit Selection

Select at level: National | Un-select at level: | Un-select all: |

Select in group: Balaka District C | Un-select in group: | Select children: |

To org unit:

- EL MOH MALAWI Govt
- (-) Central Hospital
- (-) Central West Zone
- (-) Dedza-DHO
- (-) Lilongwe-DHO
- (-) Machingo-DHO
- (-) Ntcheu-DHO
- (-) North Zone
- (-) South East Zone
- (-) South West Zone

To user: |

Subject: |

Text: |

10: When done, click **Send**.

11: If you don't want to send, but cancel the message push **Discard**.

Interpretations

User groups

DHIS 2 Online

Home Page

Launchpad Site

Text

Send Discard

## Assignment

### 1. Why should you use the messaging function?

- To exchange knowledge, ideas, solve problems regarding your workplace, colleagues etc.
- To exchange knowledge, ideas, solve problems regarding your results, the system etc.
- To exchange knowledge, ideas, solve problems regarding your personal life.

### 2. How do you write a new message?

- Go to **Messages** and click on the button **Write Message**.
- Go to **Messages** and click on the button **Write Message**.
- Go to **Sharing** and click on the button **Write Message**.

### 3. How do you choose the correct organisation unit?

- Navigate using the +/- sign and mark the relevant organisation unit.
- Search for relevant organisation unit in the **To user** field.
- It is not possible to send a message to a specific organisation unit.

## Course 1: Mentor level

The purpose of this course is to advance the mentor's knowledge and engage mentors in teaching and helping new and existing users. To start mentoring, come to an agreement with a person who needs to use DHIS2, that you will be mentoring her/him

When going through the mentoring course, we advise you to either; print out the mentor course and write down your own notes, export it to a Word file, and make your own notes. This will be helpful for you when you are mentoring others.

### 1. Introduction to HMIS and DHIS2

#### Prerequisites

Before you start mentoring a user, you need to check if the mentee/user has a user account and password. If the user doesn't have it, create one. You may have to ask your supervisor to do this. The password should not be too long, and something the mentee will remember afterwards. An example of a password that is easy to remember is: District1

#### Added value for the mentor and the health management

As a mentor you will advance your own knowledge about the system. You will also increase the knowledge of your surroundings about the system. If more potential users start using DHIS2, this will help the overall effectiveness and quality of information. This will help improving the healthcare in your district.

#### Guidelines

1. Make the mentee open the User training app and the User training course.
2. When guiding the mentee do first an introduction and explain why DHIS2 exists and the reason for using it. Mention for example that the *"better information, better decisions, better health"*.
3. Explain to the mentee the difference between national server/access and local spreadsheets.

4. Through the mentoring let the mentee solve task and try the system on they own while you watch and explain/correct.

**Common errors**

New users often forget their password. To help them remember it, make them log out and in again a couple of times after they have carried out some other tasks. Also, make them write down their username and password somewhere they can find it later, for instance in their phone.

**Assignment**

Send or answer a message to the mentor group on some reflections of what you have learned about introduction to HMIS and DHIS2.

## 2. Data entry

### Prerequisites

Before you start mentoring a user on data entry, bring a pen or some other pointer to be able to point to the + sign and other small spots on the screen. Make sure that you have the data set form with collected data that the mentee should enter into the system.

### Added value for the mentor and the health management

One of the benefits by mentoring others in data entry, are that with new users there will be more data available in the system for doing analysis, which is essential. You will also get colleagues that can help you with the workload of entering data.

### Guidelines

1. Make the mentee open Course 1, Module 2 Data entry, and start working.  
Compare data input form with the mentee's Excel sheet if any.
2. Observe closely what the mentee is clicking on and typing.
3. If a data validation check is triggered, explain that we will come back to that in the next module.
4. If something goes wrong, explain why unexpected things happened. Guide the mentee back on track by saying which menu choices to make and buttons to push. Make the mentee use the keyboard and mouse, don't take over.
5. A tip for the mentee is to use Tab button to go to the next field. Shift+Tab will bring the mentee back a step.

### Common errors

Users can often do errors if there is an interruption to Internet connectivity.

Data entry Online: If data entry is made while there is connection to the Internet, all data entered are saved automatically and instantly.

Data entry Offline: If data is entered while there is an interruption to Internet connectivity, the data is stored locally in the computer browser. When Internet connectivity is available, all data will automatically be saved. Make sure to keep your computer running.

### Assignment

Send or answer a message to the mentor group on some reflections of what you have learned about data entry.

## 3.1 Data quality

### Prerequisites

Before mentoring users on validation rules, it is important to talk about data quality. Find some examples for possible weaknesses in the data, like double counting or missing entries to show the mentee while explaining data quality.

### Added value for the mentor and the health management

By focusing on data quality, you advance your own knowledge and new and existing user's knowledge. This will help data quality throughout the whole system, and make analysis more reliable.

### Guidelines

1. Make sure the mentee understands timeliness is important to improve data quality. Data should be current, on time and at all levels. Old data is of historical value only.
2. If the mentee discovers errors in the data, make the mentee look for the source of the error and correct where possible.
3. Make the mentee understand that it is important that data is reliable and accurate enough to support decisions.

### Common errors

Human errors in collecting the data, for instance double counting or missing entries.

### Assignment

Send or answer a message to the mentor group on some reflections of what you have learned about data quality.

## 3.2 Min/Max data validation check

### Prerequisites

Before you start mentoring a user on min-max validation, you need to check the min-max ranges in the Data information window. This should be done, so you know there are ranges that the mentee can learn from.

### Added value for the mentee and the health management

By mentoring users on min-max validation, you can learn more about the health data and its background. You also learn more about the data's correctness.

### Guidelines

1. Make the mentee enter some values out of range.
2. Ask the mentee why some values change a lot, while others little; measles immunization for a month may be 0 if no vaccines are available, and high if the clinic has recently had a supply after stock out.
3. Make the mentee open the Data information window. Ask about the different fields, what they mean and how they can be used.

### Common errors

- Not writing a comment after entering a value, which has triggered a warning.
- Believing that any number outside the min-max range is wrong.

### Assignment

Send or answer a message to the mentor group on some reflections of what you have learned about min-max validation.

## 4. Data validation: data type validation and common errors

### Prerequisites

Before you start mentoring a user on data validation and common errors, you need to have some collected data to be entered in the **Data entry** form. It could also be a good idea to check the validation rules in advance.

### Added value for the mentor and the health management

You get a better understanding of the data validation rules that are within the Run validation function. You will also know more about the design of the data set forms. By mentoring others you'll spread this knowledge to new users so the overall data quality will improve.

### Guidelines

1. Make the mentee enter an invalid type of data in a field. Ask what the pop-up message means.
2. Make the mentee click the button **Run Validation**.
3. If a list of validation rules appears, ask the mentee why. Make the mentee explain how to correct the errors.

### Common errors

After getting the list of all possible errors, the mentee closes the window without having taken notice of any errors.

### Assignment

Send or answer a message to the mentor group on some reflections of what you have learned about data validation.



## 5. Data set report

### Prerequisites

Before you start mentoring a user on Data set reports, you need to find data entered yesterday or before. Before the mentee saves the Data set report on their local computer, make sure the mentee saves it on a place where they easily can access it later. An example of this can be to create their own folder where they can save reports.

### Added value for the mentee and the health management

As a mentor one will create a larger understanding for how to fetch aggregated data through the data set reports. You'll also help other to fetch this information.

### Guidelines

1. Encourage the mentee to use this report for checking data input.
2. Make the mentee go to Data set reports and find data from the day before or older. Make him/her create a Data set report.
3. Make the mentee export the report to an excel sheet. Guide the mentee on where the file should be saved.
4. Make the mentee find data that has been entered the same day. Ask about why the data is not shown.

### Common errors

Fetching a data set report straight after entering data; it takes 24 hours before one can fetch the data set report after entering data.

### Assignment

Send or answer a message to the mentor group on some reflections of what you have learned about Data set report.

## Course 2: Mentor level

### 1. Indicators

#### Prerequisites

Before you start mentoring a user on indicators, you need to calculate some examples manually to show the user. It is also wise to have some paper to write on if you're going to calculate some examples together manually.

#### Added value for the mentee and the health management

As a mentor you will advance your own knowledge about indicators; in how to calculate them manually and how to fetch them in DHIS2. This is essential knowledge to use the system. As a mentor you also do an important job in enhancing other users knowledge as well.

#### Guidelines

1. Make sure the mentee understands the definition on indicators, and the difference on input and output in DHIS2.
2. Make the mentee explain the difference between nominator and denominator.
3. Make the mentee write down the three most important indicators for her/his area.
4. Calculate some examples manually and find them in the system afterwards.

#### Common errors

Confusion between input and output, especially with the data set report, that is in the same format as the data entry form.

#### Assignment

Send or answer a message to the mentor group on some reflections of what you have learned about Indicators.

## 2. Pivot table

### Prerequisites

Before you start mentoring a user on Pivot table, you need to check that relevant data and indicators exist in the system.

### Added value for the mentee and the health management

As a mentor you will enhance your own knowledge in analysing data within the system. This knowledge you'll also give to new users that maybe is doing analysis manually or in excel sheets. By learning others to do it in DHIS2 it will make the analysis work more effective.

### Guidelines

1. Make the mentee explain while choosing indicator to make sure he/ she understands it.
2. Make the mentee open Layout. Let the mentee try out different ways of showing the data.
3. If some of the categories (like Organisation unit, periods etc.) are not shown in the table, let the mentee explain why this happens. Let the mentee try to move this categories in and out of the Filters column and see the difference.

### Common errors

When choosing Layout for the Pivot table, users often make mistakes in the Filter Column. This can be illustrated like this where periods are filtered and doesn't show when you update;

Table layout		
<b>Dimensions</b> Assigned categories Organisation units	<b>Filter</b> Periods	<b>Column</b> Data
	<b>Row</b>	
<div>Hide    Update</div>		

### Assignment

Send or answer a message to the mentor group on some reflections of what you have learned about pivot table.

## 3. Visualizer

### Prerequisites

Before you start mentoring a user on Visualizer, you need to check that relevant data and indicators exist in the system.

### Added value for the mentee and the health management

As a mentor you will as with the pivot table enhance the knowledge of how to do analysis within the DHIS2 for yourself and the users you mentor. It will make the work more effective and enhance the process of decision-making that will improve health care services.

### Guidelines

1. Make the mentee explain while choosing data element, period, organisation unit, so you know he/she understands it correct.
2. Make the mentee find favourite indicators (if they have any) in DHIS2.
3. Make the mentee make different types of charts, with different dimensions; for example a linear diagram where one compares between two facilities over time.

### Common errors

Some common errors can be

- When comparing facilities the chart only has one column.
- That no indicators are available.
- That you can't change the title of the chart.

### Assignment

Send or answer a message to the mentor group on some reflections of what you have learned about the visualizer.

## 4. Dashboard

### Prerequisites

Before you start mentoring a user on Dashboard, you need to prepare some tables, charts etc. that the mentee can add to the Dashboard.

### Added value for the mentee and the health management

As a mentor one will get a better understanding in how to make dashboards and therefore knowledge in how to create an overview that is easily accessible. You will also create a larger understanding for the mentee so that more of your colleagues start using this function. This will in the end improve the overall insight to the health care situation in your area.

### Guidelines

Make the mentee make a graph which shows indicators also from other districts. Emphasize that you can see others data, but not alter it.

1. Make the mentee explain a strategy for making a dashboard (the idea of collecting exactly these data in the same dashboard)
2. Explain the mentee that one can make several dashboards for analysis. Make the mentee add several dashboards.

### Common errors

Users can get confused by the shared dashboard at district level, and the personal (the one you create on your own). Another error that often can occur is to find your stored favourites. Make sure that your mentee names his/hers favourites something they can remember afterwards.

### Assignment

Send or answer a message to the mentor group on some reflections of what you have learned about dashboard.

## 5. Messaging

### Prerequisites

Before you start mentoring a user, you need to have some information prepared that needs to be sent as a message to a group.

### Added value for the mentee and the health management

As a mentor you will achieve a better understand in how you can send messages, and learn others as well. This will contribute to the cooperation between districts, facilities etc. This can be very important to compare results, exchange experiences etc.

### Guidelines

1. Make the mentee open the inbox to read new messages.
2. Make the mentee send a message to you (a specific user).
3. Make the mentee send a message to a specific group.

### Common errors

It can be confusing to choose correct receiver of the message.

### Assignment

Send a message to the mentor group on some reflections of what you have learned about messages.

# Appendix F: Articles

## Training mentors of health information systems through eLearning

Ellen Bjørge, Anniken Jonsson, Jens Kaasbøll and Matthieu Pinard

**Abstract:** The district health information system (DHIS) is currently used in more than 40 developing countries. The project aims in finding effective training methods to improve user's learning outcomes and in grooming mentors that can attract new users. Based on literature recommendations and a user survey, an eLearning course through an in-app in the software is under development to be used in low connectivity areas. The eLearning course will emphasize interactivity, motivation, practice exercises and feedback. In addition to the normal user level, this course also has a mentor level to be taken by some users in each site where the system is used, such that the mentors can guide new users locally.

**Keywords:** Health Information System, Low Income Countries, Superusers, eLearning.

### 1. INTRODUCTION

The introduction of ICT in developing countries has been marred by “pilotitis.” A seemingly endless stream of ICT interventions die out after the donor has left due to poor institutionalization. There are several reasons why ICT systems are unsustainable, and this research addresses low user competence, which is, particularly in rural areas, one system killer (Kimaro & Titlestad, 2008). Training in basic ICT plus system specific skills followed up by regular support visits were found necessary for a health information system innovation to succeed (Ngoma, Kaasbøll, & Aanestad, 2008). The need for local support has been addressed through training some users more than others, such that they become mentors who are able to support, guide and encourage other staff on using an ICT system (Coulson, Shayo, Olfman, & Rohm, 2003; McNeive, 2009). While acknowledged as a viable strategy towards sustainability of the systems, the approach so far has been to just provide more training for those selected to become mentors. This is an expensive method when scattered trainees need to join up for several days in a central city. The research in progress reported here aims at developing efficient methods for training mentors in rural settings in low and middle-income countries, thus contributing to sustainable information systems.

Reaching out to potential mentors in rural districts can be achieved through a distant learning approach supported by an eLearning course. Based on review papers, we establish nine conditions that such training should meet. Distance training by means of ICT has in general had modest success (Hattie, 2009), and intermittent electricity supply and unpaid internet subscriptions which are often the case in the relevant setting make eLearning more challenging. However, studies suggest that the following functionality will enhance learning (Cook et al., 2010);

1. Feedback
2. Practice exercises
3. Repetition
4. Online discussions
5. Audio

Many conditions are required for people to use at work what they have learnt in courses (Grossman & Salas, 2011). Some of these can be affected during training:

6. Motivation. Learners find the training useful and are motivated to learn and apply new competence at work,

*Proceedings of the 13<sup>th</sup> International Conference on Social Implications of Computers in Developing Countries, Negombo, Sri Lanka, May 2015*



7. Self-efficacy. Can be improved through watching a peer believed to have similar abilities as yourself, solving a problem.
8. Realistic training environment with close resemblance between the subjects taught and work tasks. This implies the same software being used for training and work.
9. Learning anticipating and handling problems.

Based on these factors, the project will develop an eLearning course implemented as an app extension to the web enabled routine District Health Information System (DHIS, 2014), which can work in locations with poor connectivity. Such an approach can reduce training costs, thus contributing to a sustainable training approach for learning of information systems.

The research questions are

1. What is the necessary training and support to make people who are neither managers nor computer scientists able to champion and support a health management information system at their workplace?
2. How can eLearning courses be designed to improve user competence in areas with poor connectivity?
3. What is the outcome of eLearning courses compared to face-to-face training?

## 2. SETTING

This project builds on achievements made in health information systems research (Braa & Sahay, 2012), particularly the implementation of the DHIS in more than 40 countries.

The setting for this research will be the health management information system of Malawi, where the integrated DHIS has been implemented. Malawi has 29 district health offices where data is entered from paper forms to the web system. In each district office, there are 20 or more health programme coordinators, one Health Management Information Systems (HMIS) officer who has HMIS with the DHIS system as their prime task, and a few clerks who help out on data entry and other system related tasks. The total of 600 programme coordinators at district level need to learn the DHIS for analysing their monthly data collected from facilities on paper and entered into the database in the district offices. The coordinators in districts are often transferred, such that new ones have not taken part in any DHIS training. HMIS officers and clerks are more stable, such that the training will target these groups.

The DHIS is run through a web browser and stores data in a national server. Due to the number of data concepts (organisation unit, data element, period, data set, validation rule, indicator, graph, ...) there is no easy fix to make it look simple at the user interface. Therefore, considerable learning efforts are required to be able to use it efficiently.

## 3. METHOD

The research is carried out in three stages.

1. Survey of mentor competence. A questionnaire was sent to the global DHIS user e-mail list asking about their opinions of what a mentor should be able to do. The list had 716 members in six continents, most living in LMIC. Fifty useful responses were received, which is a 7% response rate. Wilcoxon's signed-rank test was used for testing differences between high and low Likert scale responses, since no normal distribution was assumed.
2. Development of Apps & Learning material – iterated. Each iteration will consist of a design and an evaluation phase. The purpose of the evaluations will be to find as many issues in the learning material as possible, thus variation amongst the test subjects is valuable, while representativeness is of little concern. The data from the observations and interviews will be analysed qualitatively, aiming at finding reasons for learning and non-

learning in the learning material. This project is currently in the design phase of its first iteration.

3. DHIS aims at providing indicators to health management. To measure the effect of the training, the final evaluation will assess the average number of reports generated from the system per health manager. This number is found in system logs. Around 20 health managers work in each of the 29 district offices. eLearning will be carried out in ten offices, while no intervention will be carried out in a control group of ten other offices. To gauge the effect of the eLearning over time, the average number of reports will be measured monthly from month 4 to 9 after training commenced and at the same period in the control group. Assuming that face-to-face training is more effective than eLearning, face-to-face training will be carried out in the remaining nine districts, and the same evaluation will be carried out there. The evaluation will thus provide a measurement of the effectiveness of the eLearning vs. no training and vs. face-to-face.

#### 4. SURVEY RESULTS

Table 1 lists the rank and mean scores of responses to the question on what mentors should be able to do. On the 1-6 scale, all mean scores are above the middle choice of 3.5, implying that mentors should be able to do everything. However a couple of findings seem relevant when designing mentor training.

Rank	Ability	Mean score
1	encourage other users to use the system	5.4
2	guide other users such that they become able to solve other problems themselves	5.3
3	guide other users such that they become able to solve the particular problem themselves if the problem reappears in the future	5.2
4	communicate with IT people	5.2
5	achieve trust from others	5.2
6	learn new IT solutions, changes, and updates	5.2
7	solve IT related problems	5.1
8	argue convincingly for the purpose of the system towards other users	5.1
9	achieve social ties with others	5.0
10	observe misfits between IT and business	4.7
11	carry out IT related tasks which other users don't want to do	4.6

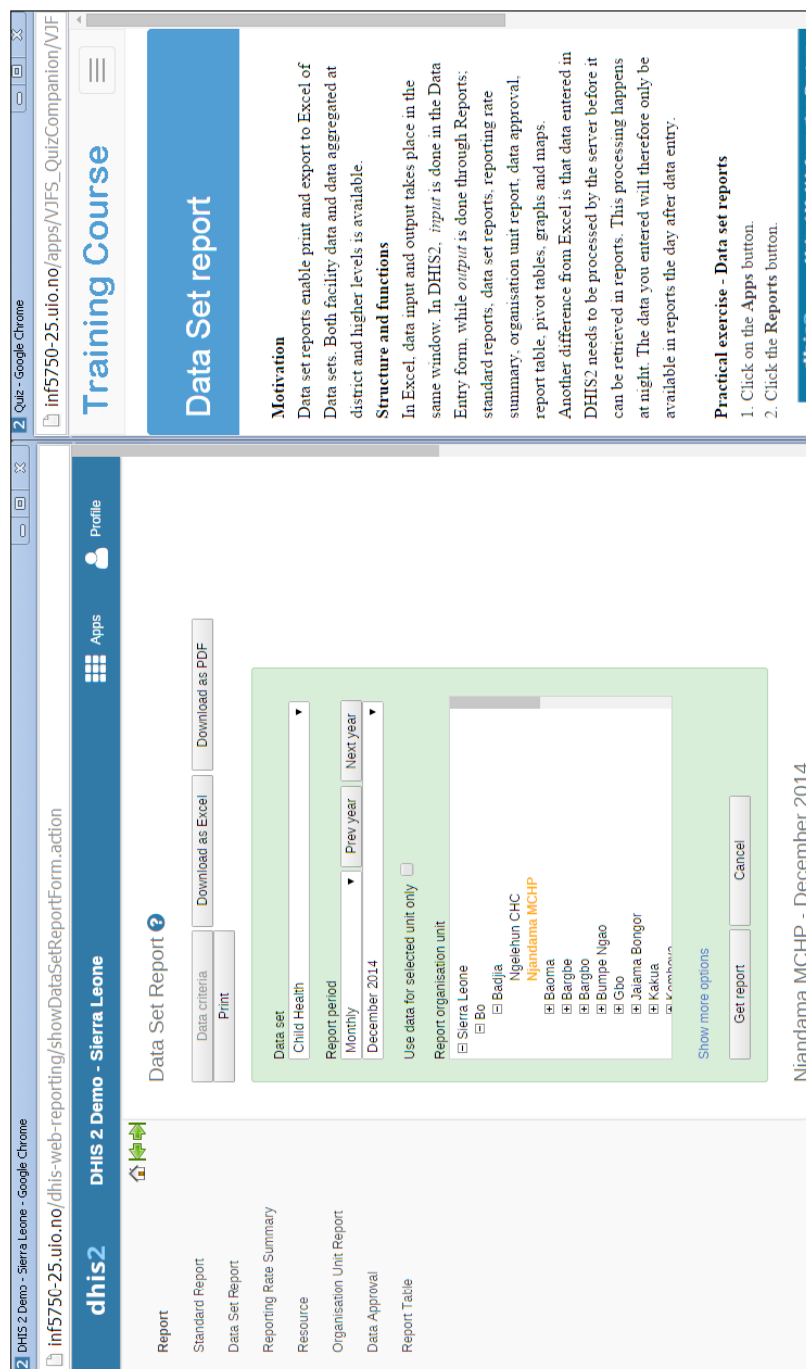
**Table 1. To which extent should a mentor be able to ... (Shaded area: significantly lower scores than Rank 1)**

Mentors' abilities to get others to use a system are ranked highest amongst the scores. It would be likely that "argue convincingly for the purpose of the system towards other users" would have had a similar score. However, this alternative is marginally significantly below the rank 1 score. One reason may be that the ability to encourage is deemed more important than the ability to argue. This may imply that mentor training should aim at developing their capacity for encouraging others, which is in line with previous studies (McNeive, 2009; Poe, Abbott, & Pronovost, 2011).

The ability to learn solving problem yourself came out as rank 2 and 3 in the question. Based on other questions, the results were split into respondents being help givers versus receivers. The outcome was that those who mainly *receive* help think that mentors should be able to guide other users both such that they become able to solve the particular problem and other problems themselves to a significantly higher degree than those who mainly *provide* help. Hence the less skilled want to learn to be able to solve problems themselves, while the more advanced do not seem to acknowledge that the less skilled want this.

#### 5. APPS

The DHIS2 can be extended by apps, which are also running on the users' computer. Having in-app training as part of the software to be learnt meets condition 8. It will show up in a separate browser window with no overlap with the application see illustration below.



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The DHIS operates in areas with poor internet connectivity through minimised data transfer and offline mode when the network is down, and the training apps will follow suit, again fulfilling condition 8. Functionality for sharing experiences during course taking may also be implemented in a mobile phone app, meeting condition 4.

The course evaluation app will be able to log the activities of a chosen group of users for specified time periods. The output will be anonymised in order to avoid ethical issues on surveillance of health workers.

## 6. LEARNING MATERIAL

The user learning material will consist of one module per topic. For each topic, there will also be a mentor module aimed at bringing the users to the level where they can support others.

A user course will consist of 3-5 modules like this:

1. Presentation (2 pages, possibly a few seconds of video (5)).
  - a. Motivation for the usefulness. (Condition 6)
  - b. Structure & function. Presentation for understanding in order to be able to solve problems and guide others (9).
  - c. Practical exercise. Sequence of steps for doing the operations for learning the skill (2).
2. Assignment. One or more of
  - System log showing that the Learner has accomplished the task on the system, requiring that the task is repeated during three days (3)
  - Quiz with feedback on the answers (1).
  - Approval from a more experienced colleague. (1)

For completion of a course, the learner also has to contribute to an online learning community, meeting Condition 4. After completion, the user will receive a certificate from the Ministry of Health and the UiO, confirming management recognition.

After completion of a user course, the learner will be allowed to start up the mentor course on the same topics. The mentee will be a colleague, possibly with higher status than the mentor (Condition 7 for the mentee). A module:

1. Presentation (2 pages with links to User Manual and other documentation, possibly video).
  - a. Prerequisites for the mentor to prepare.
  - b. Guidelines of how to supervise the mentee during the corresponding tasks in the User course (2).
  - c. Issues, which people have when learning this topic (9), also preparing for problem solving as was suggested in the survey.
2. Assignment. One or more of
  - System log showing that the Mentee has repeatedly accomplished the task on the system (3).
  - Quiz (1).
  - Approval from the mentee (1).
  - Write issues that arouse during mentoring in online mentor community.

## **Mentor 5. Data set report**

### **Prerequisites**

Before you start mentoring a user on Data set reports, you need to find data entered yesterday or before. Before the mentee saves the Data set report on their local computer, make sure the mentee saves it on a place where they easily can access it later. An example of this can be to create their own folder where they can save reports.

### **Added value for the mentee and the health management**

As a mentor one will create a larger understanding for how to fetch aggregated data through the data set reports. You'll also help other to fetch this information.

### **Guidelines**

1. Encourage the mentee to use this report for checking data input.
2. Make the mentee go to Data set reports and find data from the day before or older. Make him/her create a Data set report.
3. Make the mentee export the report to an excel sheet. Guide the mentee on where the file should be saved.
4. Make the mentee find data that has been entered the same day. Ask about why the data is not shown.

### **Common errors**

Fetching a data set report straight after entering data; it takes 24 hours before one can fetch the data set report after entering data.

### **Assignment**

Send or answer a message to the mentor group on some reflections of what you have learned about Data set report.

Creating a community of mentors helps improving their practice (Wenger, 1998), which has also been found beneficial also for more advanced training of DHIS implementers (Siribaddana, 2014).

## **7. CONCLUSION**

Based on literature, the research question on how to design eLearning courses to improve user competence in areas with poor connectivity should fulfil nine conditions. A survey in the user group indicated that encouraging others should be top priority for those mentoring others, and that mentees wanted to learn how to solve problems. A user course plus a mentor course were designed according to these conditions as an in-app that is part of the software DHIS. The mentor course aims at developing local personnel to become IT mentors for colleagues, and such courses have not been found in the literature. The same strategy can be used for all distributed business systems.

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# From user training courses and central support To creating local user competence for mentoring colleagues: a preliminary study in Malawi

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**Abstract:** Learning to use distributed business systems requires expensive and sustained training efforts. An approach to nurture local users to become mentors for colleagues has been developed as an alternative to training courses. A user level plus a mentor level distance learning course were evaluated amongst users of a health information system in Malawi. The user level course was adequate for users with some computer fluency, while IT novices required a mentor present. The mentor level course required the mentors to have higher system competence than most of the relevant users had. An advanced level course between the user and the mentor levels is therefore suggested, in addition to including more practicals and cooperative, reflective components in the mentor course. With such amendments, distance learning courses can replace most face-to-face training courses and training of trainers approaches for implementation of information systems.

**Keywords:** User training, user learning, implementation.

## 1. Introduction

The introduction of ICT in developing countries has been marred by “pilotitis.” A seemingly endless stream of ICT interventions die out after the donor has left due to poor institutionalization. There are several reasons why ICT systems are unsustainable, and this research addresses low user competence, which is, particularly in rural areas, one system killer [1]. Training in basic ICT combined with system specific skills then followed up by regular support visits were found necessary for a health information system innovation to succeed [2]. The need for local support has been addressed through training some users more than others, such that they become mentors who are able to support, guide and encourage other staff on using an ICT system [3, 4]. While acknowledged as a viable strategy towards sustainability of the systems, the approach so far has been to just provide more training for those selected to become mentors. This is an expensive method when scattered trainees need to join up for several days in a central city. Also, efficient methods to train up to the mentor level have not been scientifically tested; implying that high cost training may yield limited results. Previous research points to that training which aims at understanding underlying structures in the system combined with explicit teaching of problem solving techniques and principles for how to guide others may bring learners up to the mentor level [5].

Understanding the purpose of the IT and its usefulness in business is a necessary motivation for many learners of IT [3, 6]. Users prefer operating the IT system to reading documentation, implying that learning material should be as short as possible [7]. Also,

imitating others or following a detailed instruction of how to operate the computer has proven effective for learning IT skills [8-10].

Reaching out to potential mentors in rural districts can be achieved through a distant learning approach supported by an eLearning course. The field of Computer Supported Collaborative Learning (CSCL) focuses on how learning happens through collaboration with others through activities such as games, projects etc. and tools such as computers, internet etc. A main concept within CSCL is the *zone of proximal development*. The zone is the range of learning that can be achieved when a mentor (teacher, colleague etc.) helps the mentee when a task is otherwise too difficult to solve on his/her own. In this way the mentee can reach a higher level of knowledge, and increase it stepwise [11]. The mentor's help to make the mentee succeed in solving problems is called *scaffolding* [11], and it can include any tools such as software, written explanations and what is known in science and technology learning as conceptual models [12].

*Collaborative learning* is also an important strategy in CSCL [13]. It is a coordinated, synchronous activity where individuals negotiate and exchange meanings for constructing a shared conception [13].

One way of mentoring is the *inquiry based learning*, where the mentor presents some scenarios for the mentee. From there the mentee should ask some questions to investigate and collect evidence, reflect upon findings and report back to the community (class, network etc.). This type of mentoring also emphasizes group work, where the mentor works as a facilitator and an expert [14].

## 2. Objectives

In addition to the requirements mentioned above, training should also reach out to potential mentors in rural districts, with a distance training approach. This study therefore aims at finding feasible course contents and organisation for distance study of IT user competence. Such an approach will reduce training costs, thus contributing to a more sustainable training for information systems users.

Specific objectives are finding:

1. a minimum set of learning material modules including detailed instructions and scaffolds for understanding underlying structures.
  2. a sequence of training where each step lies within its zone of proximal development and where the end step brings it to the mentor level.
  3. a way of organising for communication such that learners at the same level can discuss.
- The material for user training is aimed at the end user of a particular health information system in Malawi. The mentor level material is intended for mentors of any information system which is built on the same generic software package as the Malawi system. The mentor training approach aims at any distributed information system.

## 3. Methodology

The development of this material has been carried out in two cycles of design and evaluation. The case has been the District Health Information System (DHIS) in Malawi. Malawi has 29 district health offices where data is entered from paper forms to the web system. In each district office, there are 20 or more health programme coordinators, one Health Management Information Systems (HMIS) officer who have HMIS with the DHIS system as their prime task, and a few clerks who help out on data entry and other system related tasks.



### *Exploration cycle*

The first cycle consisted of an initial design of two training modules followed up by interviews with users in Malawi. We visited seven districts in the central and southern region. We interviewed nine persons in total and these were HMIS officers, program coordinators and clerks. They were chosen since we wanted to interview persons with different work tasks and backgrounds. Their IT competence varied, but in general their competencies were low. In the interviews we focused on their background, how often they use the system and what kind of training they have had in the system. At the end of each interview we had a practical assignment where we handed out the modules we had made. This consisted of one basic module and a draft of an advanced module. The response to the basic module was that this would be helpful in learning the tasks. There was no particular feedback on the advanced module. A reason for this may be due to their general low IT competence and because they can't use the specific feature of the system. All interviews were conducted in English, since the system is in English, the official language of Malawi is English and the health workers were fluent in the language.

### *Evaluation cycle*

During this cycle we redesigned the training into two levels; user level and mentor level. The user level consists of ten basic tasks in DHIS2, followed by ten mentor modules on the same topics. These modules were tested during our second visit to Malawi. We had two weeks available and would have to visit all district offices twice. Each visit consumed one day, such that a maximum of five districts were possible. Since one visit was cancelled, we visited four different districts in the southern region, and went through all modules in two rounds. During the first round we went through the user courses with two HMIS officers and two clerks. These were assigned to mentor other users of the system during the second round. Each session during the first round lasted for approximately two hours. During these sessions the learners went through the ten modules on the user level, and did the assignments. Their task to the next session was to read through the mentor course, and make preparations in order to mentor others.

During the second round, each session lasted for two hours. During these sessions, the HMIS officer/clerk mentored other users through the ten modules. The skills of the mentees varied from computer novices to fluent IT users.

## **4. Technology Description**

DHIS is a generic software package for hierarchical organisations, enabling aggregation of statistics and tracking cases following specified processes [15]. The DHIS is run through a web browser and stores data in a national/central server. The functionality is organised in apps, being extensions which can be added or subtracted from an installation. Beware that these apps differ from what people install on smartphones in three ways. The DHIS apps are parts of the larger database system, they are stored in the web server, and they can run in browsers in any device. Due to the number of data concepts (organisation unit, data element, period, data set, validation rule, indicator, graph, maps...) there is no easy fix to make the system look simple at the user interface. Therefore, considerable learning efforts are required to be able to use it efficiently.

The learning material will be included in a specific app, currently under construction. The app will occupy the right ¼ of the screen on a computer or tablet, leaving the rest of the screen for working on the DHIS software. Until this app is finished, the training modules are made in a text processor and the users are given prints.

## 5. Developments

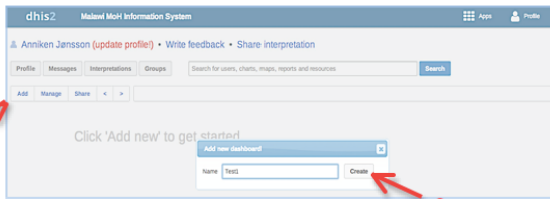
### Exploration cycle

The Basic module developed for the exploration is shown in Figure 1. It consists of a step-by-step instruction to carry out a task in the system.

**DASHBOARD**

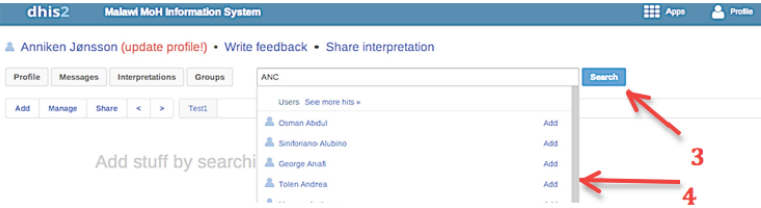
1: Click on add

2: Name your dashboard and enter create



3: Search relevant users, charts, pivot tables, standard reports etc.

4: Click add to add it to dashboard



You have now created a dashboard with chosen table

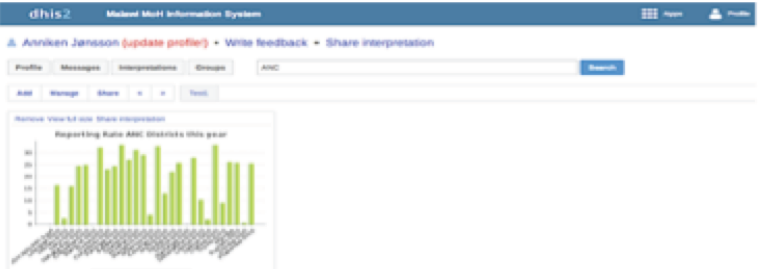



Figure 1. Basic module tested during the first, exploratory cycle.

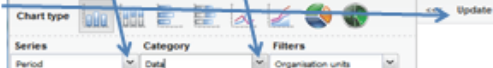
A draft of an advanced module targeted at user with experience on the advanced report generation module was also developed and shown to the informants/trainees, see Figure 2. There was no particular feedback due to the low level of experience with this report module amongst the informants/trainees.

**Graph looks weird**



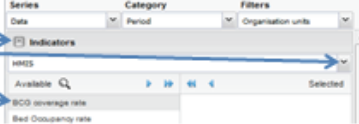
You have chosen Period in Series (Y-axis).

1. Exchange Period and Data in Series (Y-axis) and Category (X-axis)
2. Click Update




**No Indicators are available**

1. Click Indicators
2. Click Down-arrow to select an indicator group
3. Select your programme or HMIS for common indicators
4. Select indicators by DOUBLE-click (or single click and use the small, blue right and left arrows)



**I want to compare districts. How to select more than one?**

1. Hold the ctrl key down when clicking on the organisation units to include



**The general way of improving charts**

1. Make one change at a time:
  - a. Ill-structured chart → change Series, Category, Filter.
  - b. Values of Categories and Filters → change Organisation units or Periods.
  - c. Values which the graph displays → change Indicators, Data elements or Reporting rates.
  - d. Title, trend lines, target lines, axis etc. → change Options
2. Click Update
3. Repeat

Figure 2. Part of a module for solving problems occurring in the visualizer app, including a general method.

The Exploration cycle in general showed that most users only used a couple of the apps in the system and that their general IT competence was low.

### Evaluation cycle

Based on the findings during the Exploration cycle, it was decided to split the course in two levels; User and Mentor.

The user learning material consists of one module per topic. For each topic, a mentor module was also designed aiming at bringing the users to the level where they can support others.

A user level module consisted of presentation and assignment, see example in Figure 3: Presentation

- a. Motivation for the usefulness. Each module introduces the purpose of the functionality by referring to some tasks users need to carry out in their job, see Figure 3. Seeing the usefulness of the system in their own job is essential for learning, as mentioned in the Introduction.
- b. Structure & function. While many users immediately understand objects and relationships visible on the user interface, understanding structures hidden behind the surface is more challenging. Some users generate a adequate understanding on their own, but slow learners are particularly bad at doing this [16]. Understanding underlying structures is important for solving problems [17, 18]. The presentation of structures and functionality is therefore included to prepare users for more challenging tasks.

- c. Practical exercise. Practice is essential for learning [19]. Each module therefore has a sequence of steps for carrying out the computer operations. In order to cater for as low skilled users as possible, the steps are illustrated by screenshots to ease interpretation.

Assignment. One or more of

- System log showing that the Learner has accomplished the task on the system, requiring that the task is repeated during three days
- Quiz with feedback on the answers.
- Approval from a more experienced colleague.

Due to the paper mock-up, only the quiz could be carried out during the Evaluation.

After completion of a user course, the learner will be allowed to start up the mentor course on the same topics. The mentee will be a colleague, possibly with higher status in the organisation than the mentor. A module will consist of (see Figure 4):

1. Presentation
  - a. Prerequisites for the mentor to prepare.
  - b. The organisational benefits for motivation.
  - c. Guidelines of how to supervise the mentee during the corresponding tasks in the User course. This should trigger some inquiry based learning. Setting up the case is included in the Prerequisites.
  - d. Issues which people have when learning this topic. Confronting people's misconceptions is an efficient way of improving their understanding [20]. Recognizing a misconception is easier if the mentor has been informed of those that occur regularly. This item is intended as a scaffold for developing the mentor's ability to unveil and confront mentees' misconceptions.
2. Assignment.
  - Quiz for encouraging practicing the prerequisites.
  - Write issues that arouse during mentoring in online mentor community in order to support collaborative learning amongst mentors.

## 5. Data Set report

### Motivation

Data set reports enable print and export to Excel of Data sets. Both facility data and data aggregated at district and higher levels is available.

### Structure and functions

In Excel, data input and output takes place in the same window. In DHIS2, *input* is done in the Data Entry form, while *output* is done through Reports; standard reports, data set reports, reporting rate summary, organisation unit report, data approval, report table, pivot tables, graphs and maps.

Another difference from Excel is that data entered in DHIS2 needs to be processed by the server before it can be retrieved in reports. This processing happens at night. The data you entered will therefore only be available in reports the day after data entry.

### Practical exercise - Data set reports

1. Click on the **Apps** button.
2. Click the **Reports** button.



3. Click on the **Data Set Report** button to enter the data set reports.



4. Choose relevant data set.
5. Choose relevant frequency of period.
6. Select wanted year. If one chooses monthly above, select wanted month.

7. Select organisation unit by using the + / - button until you find correct unit, then mark it orange by single clicking on the name.

8. Push **Get report** to create the data set report.



9. You can download your report as an Excel sheet, PDF-file or print by a single click on these buttons.



### Assignment

1. What is the difference between data input and output in DHIS2?

- a. Output is typing the numbers in the Data entry form.
- b. Output is retrieved from reports, while input is through Data entry.
- c. Input is done through Data entry, and output consists of exporting Data entry to Excel

2. What is a data set report?

- a. The same as the data entry form.
- b. Facility data and aggregated data at district and higher levels.
- c. Facility data and patient data at district and higher levels.

3. How do you choose report period?

- a. Click on get report
- b. Choose year and then frequency.
- c. Choose frequency and then year

Figure 3. User level module

## **Mentor 5. Data set report**

### **Prerequisites**

Before you start mentoring a user on Data set reports, you need to find data entered yesterday or before. Before the mentee saves the Data set report on their local computer, make sure the mentee saves it on a place where they easily can access it later. An example of this can be to create their own folder where they can save reports.

### **Added value for the mentee and the health management**

As a mentor one will create a larger understanding for how to fetch aggregated data through the data set reports. You'll also help other to fetch this information.

### **Guidelines**

1. Encourage the mentee to use this report for checking data input.
2. Make the mentee go to Data set reports and find data from the day before or older. Make him/her create a Data set report.
3. Make the mentee export the report to an excel sheet. Guide the mentee on where the file should be saved.
4. Make the mentee find data that has been entered the same day. Ask about why the data is not shown.

### **Common errors**

Fetching a data set report straight after entering data; it takes 24 hours before one can fetch the data set report after entering data.

### **Assignment**

Send or answer a message to the mentor group on some reflections of what you have learned about Data set report.

*Figure 4. Mentor level module.*

## **6. Results**

The material developed in the evaluation cycle was tested in two rounds. The first round – the user level courses, and the second round – the mentor courses were tested. During the sessions in the first week, we observed how they worked with the courses and got feedback on some minor mistakes in the user level courses. The learners were fluent in data entry and a couple of other apps in the system. When going through the user level courses it was clear that some of the other modules were new.

*I have wondered about what this is, but I have not known what to do or how to do it.  
(HMIS Clerk)*

Our impression after the first round was that learners who are fluent in IT would manage the courses as a self-study well, implying that the updated written modules would be sufficient scaffolds.

Computer novices will need guidance from a mentor in order to complete the courses. When the tasks are too difficult for the mentee to solve on his/her own, the mentor will become a scaffolder. In this way the mentee can reach a higher level of knowledge that they would not have managed without the mentor function.

During the second round the mentor modules were tested. After mentoring others, the mentor would complete the course and become a mentor. What we could see during the mentoring sessions was that the distance between the user level and the mentor courses was too big. In order to mentor others, the mentors should have more comprehensive practice and deeper understanding of the software. When facing problems, they should be fluent in the software in order to solve these problems and guide others through the problems. In order to achieve this, an intermediate course could be a solution. In this course there should be activities focusing on problem solving and reflection, and giving the user time to experiment with the software. We could see that the fear of doing mistakes in the system was strong, and this can implicate that the user does not have the competence needed.

The mentors observed were mainly able to guide the other user through the courses. They had read through the mentor course, but little practical preparation to the course had been done.

*I just went through the mentor course to see what I was supposed to do, and what I was supposed not to do. (HMIS clerk)*

Some of the guidelines in the mentor modules were followed, but the assignments had not been carried out. In summary, the mentor course needs more elaboration to become a sufficient scaffold.

## **7. Business Benefits**

The general nature of the DHIS makes the user interface less targeted to specific domains than would software designed from scratch for a particular business. While DHIS is open source, also commercial packages like SAP follow the same generic pattern. This generality may create additional learning challenges. However, it also enables reuse of learning material with possible adaptations for a wide range of installations. Since the DHIS health databases are adapted to the country requirement, the examples in the user course material were adapted to the Malawi database. One user tried a demo database with other data and the course material for Malawi, and he did not get far due to the discrepancies in the examples and his unfamiliarity with the demo database setup. This points to that the user level should be tailored to the specific database.

However, the mentor level was not tailored to any specific database setup and could be user anywhere. With DHIS being used for health management in more than 40 low and middle income countries, the basic course can be adapted and the mentor course can be used as is in these settings, provided English is their working language. Staffs in district offices in Malawi are fluent in English, such that no translation to local language was necessary. Other countries may require translations.

DHIS is also used in other domains, including agriculture and education. Again the mentor course could be used, while the user level needs adaptation. The research results of training mentors can also apply to user training also for other software.

## **8. Conclusions**

The objectives were to develop training material for people to obtain user skills in the first place, and second, mentor level competence for guiding other users.

The user level course consisted of a series of modules. Each module included three components; the motivation, an explanation of data structures, and a step-by-step list of instructions to be carried out. In the end, each module had a quiz addressing each of these

three components. The user level course met its mission, even if a few minor mistakes in the material were spotted. The courses have been updated accordingly before distributed more widely. For learners who were fluent on computers, the written course constituted a sufficient scaffold. Computer novices needed guidance from mentors as an additional scaffold. This corresponds to previous findings [21], emphasizing the need for local mentors to help out novices.

While there is a body of research on user learning and training [22, 23], we have not found any literature on how people develop into IT mentors. The mentor level course modules concerned the same topics as the user level modules, but the components of the mentor level modules were attuned to the mentor role; prerequisites, added value for the business, guidelines on how to mentor and common errors made by learners. An appeal for writing about the experience of mentoring in a mentor message group in the software was also included. The mentor would complete the course after having mentored another user through the user level.

While the observed mentors were mainly able to guide their mentees through the user course, two main weaknesses with the course set up were observed.

First, the mentors should have had a more comprehensive practice and advanced understanding of the software use before mentoring others. This calls for an additional course level of more advanced use before embarking on the mentor course. Given that mentors need to help other users solving their problems, the intermediate course should have assignments being farther from the step-by-step instructions. Good problem solvers work in systematic manners [24] and combine experimentation and search for help [25]. An advanced module including a method for problem solving within one of the DHIS apps (Figure 2) was initially presented to the users, but it was abandoned due to being above their level of use. Such modules may be included in an advanced user course.

Second, the mentor course was not interactive enough. The mentees have read through, but practical preparation was little. Research points to that more activities and reflection/analysis in general improve learning [19]. Adding mandatory practical assignments in the course would require more mentor activity, and examples of such activities can be communicated in a mentor user group. Examples are setting up cases in the software, observing other users creating smart solutions or making mistakes, and demonstrating outcomes and impacts of the system. By setting up cases in the software before mentoring others, the mentees can investigate and reflect upon findings. This corresponds to the theory about inquiry based learning, where the mentee explores his/hers ideas regarding the scenario, collect evidence to these ideas and then presenting them to a community or in this case the mentor. Here the mentor will be the facilitator and guide the mentee to the right solution. Sharing experiences, problems and solutions with other peers can strengthen the learning process, according to the collaborative learning principle from CSCL [13]. With these two amendments, we believe that the mentor course will constitute a sufficient scaffold for the mentoring role.

Bringing the course developer or some other expert into the conversation can improve the mentors' understanding [20]. This would require additional efforts compared to the self-managed learning intended.

In order to get a process of taking user courses and mentoring others started throughout an organisation, management pressure and incentives might be needed. The mentors doing the real world evaluation of the material were awarded by a diploma, which was accredited by us as researchers. This diploma was more appreciated than expected.

The previous two findings – need for interactivity and reward – combined with the fact that regular training over time tends to be more efficient than one-off sessions [2], pushes us to explore the integration of basic gamification of the courses. This could imply a learning path where points are earned for each stage or session. Once all the modules of the



basic user level are completed, the trainee could start the intermediate level course. The mentor level, available after completion of the intermediate level should be presented as a rewarding next step. Diploma should be distributed at the end of each level. This way the user builds up a set of skills over time and the system keeps track of the evolution.

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